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Environmental Aspects of the New-Source NPDES (National Pollutant Discharge Elimination System) Permit Program for the West Virginia Surface Coal Mining Industry, 1977-1980

Jack McCormick and Associates, Inc., Berwyn, Pa.

Prepared for

Environmental Protection Agency, Philadelphia, Pa. Region III

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JACK McCORMICK & ASSOCIATES, INC.
A subsidiary of WAPORA, Inc.

511 OLD LANCASTER ROAD
BERWYN, PENNSYLVANIA 19312
(215) 647-9000

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March 1977

FINAL REPORT
on
ENVIRONMENTAL ASPECTS OF THE NEW-SOURCE NPDES PERMIT PROGRAM FOR THE WEST VIRGINIA SURFACE COAL MINING INDUSTRY,

1977-1980

Submitted to: Mr. Robert Blaszczak
Project Monitor
US-EPA Region III
Sixth and Walnut Streets
Philadelphia, Pennsylvania 19106

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This report was prepared to assist US-EPA III as it extends its regulatory purview to the West Virginia surface coal mining industry under the National Pollutant Discharge Elimination System (NPDES) established by the Federal Water Pollution Control Act Amendments of 1972 (FWPCA, P.L. 92-500). It (1) describes existing conditions and trends in the surface coal mining industry, (2) identifies known environmentally sensitive resources throughout the State, (3) comments on the probable future flow of applications for new-source NPDES permits and on policy alternatives which must be specified by US-EPA as the new program is implemented, and (4) presents the conclusions and recommendations of the consultant to US-EPA Region III for implementation of the NPDES program.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
6TH AND WALNUT STREETS
PHILADELPHIA. PENNSYLVANIA 19106

April 28, 1977

Attached for your information is a copy of a report entitled Environmental Aspects of the New Source NPDES Permit Program for the West Virginia Surface Coal Mining Industry, 1977-1980. This report was prepared for EPA by Jack McCormick and Associates, Inc. (a subsidiary of WAPORA, Inc.) to assist EPA Region III in implementing the requirements of the National Environmental Policy Act (NEPA) in the processing of new source NPDES permits for surface coal mines.

The term "new source" means any source the construction of which is commenced after the publication of proposed regulations prescribing a standard of performance under Section 306 of the Federal Water Pollution Control Act Amendments which will be applicable to such source, if such standard is thereafter promulgated in accordance with Section 306. Since proposed standards of performance for the coal mining industry have not yet been published, no new mining activity at this time can be termed a "new source". EPA Region III, in anticipation of the publication of standards of performance, is in the process of establishing a procedure which will provide for the timely review of new source mine permit applications and compliance with NEPA. The attached report is intended to assist EPA in this endeavor.

EPA Region III has not decided on a particular course of action to date. The opinions, conclusions, and recommendations stated in the report are that of EPA's consultant and should not be construed as EPA's position or policy. EPA takes particular exception to several statements made in the report. The statements in question and EPA's position are presented in the Attachment, "Clarification of EPA Position."

All questions or inquiries concerning this report should be addressed to Mr. Robert J. Blaszczak, Project Monitor (3WA22), U. S. Environmental Protection Agency Region III, 6th and Walnut Streets, Philadelphia, Pennsylvania 19106.

Sincerely yours,

George D. Pence, Jr.

George D. Pence, Jr.
Chief, Environmental Impact Branch

Enclosure

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Attachment

Clarification of EPA Position

1. Consultant's Statement: Page 148, last paragrpah:

"The US-EPA general new-source NPDES environmental regulations published on 11 January 1977 indicated that it was not considered feasible to establish a threshold defining minor Federal NPDES permit actions which will not significantly affect the environment (comment on 40 CFR 6.904, 42 FR 2451), so every permit application will have to undergo a NEPA review which culminates in either a negative declaration notice (accompanied by an Environmental Appraisal file report) or a notice of intent to prepare a formal EIS (40 CFR 6.904, 6.906, 6.908) unless the regulations are amended. No permit can be issued until such environmental review is complete, and a specified period has elapsed after Federal Register publication of the negative declaration or filing of the final EIS with the CEQ (40 CFR 6.909.2., 42 FR 2455)."

EPA's Position: In the January 11, 1977 Regulations noted above EPA stated:

"Several commenters raised the issue that the responsible official should be able to designate certain actions as not being "major Federal Actions significantly affecting the quality of the human environment" and therefore not be subject to NEPA. Although EPA agrees with this concept in theory, EPA determined it was not feasible to create threshold exemptions under the regulation."

The regulation referred to is the January 11, 1977 regulation which, as the contractor noted, is a general type regulation. EPA's statement considered only the feasibility of including threshold exemptions in the general regulation. The statement did not preclude the possibility of establishing threshold exemption criteria in future regulations or guidance on a particular industrial source category.

2. Consultant's Statement: Page 174, middle of second paragrpah:

"US-EPA Region III is reluctant to prepare one or more formal EISs on the West Virginia surface mining industry, because such a procedure apparently will stop the issuance of any new-source NPDES permits for the industry that have not undergone their own formal EIS review."

EPA's Position: EPA Region III is aware that the implementation of NEPA with regard to the West Virginia surface mining industry could have significant ramifications. It is therefore important that EPA evaluate and consider all possible options before making a decision on preparing an EIS.

The consultant is referring to an areawide EIS approach which would address mining activities within a designated study area. If such an approach were adopted, new source permits could not be issued to individual new source mines unless it could be demonstrated that an individual source does not significantly contribute to the accumulative impacts resulting from other new source mining activities. If this independence could be demonstrated the new source would then receive an independent NEPA review which would culminate with a Negative Declaration or an EIS.

It should be noted that proposed Standards of Performance for the coal mining industry have not been published. By definition, a new mine cannot be a new source unless Standards of Performance have been published. Therefore, given this situation, if EPA were to initiate areawide EISs, no new mining NPDES permits would be delayed or affected in any way by the EIS. A potential problem could arise if new source Standards of Performance were published before the EISs are completed. If this situation were to arise, a case by case determination would be necessary to identify those projects which should undergo a separate NEPA review.and those which would be held until completion of the areawide EIS.

3. Consultant's Statement: Page 175, second paragraph:

Threshold exemptions from routine, detailed NEPA review and from "Best Practices" based on tonnage of coal produced are beset with practical difficulties of implementation to the West Virginia surface coal industry, as described in Chapter III. They have not yet been described by proposed regulations in the Federal Register or in final written guidance to Regional Administrators, and their effects on (1) the public involvement aspects of NEPA review and (2) the accomplishment of inter-agency coordination requirements based on laws other than NEPA are difficult to anticipate. Such exemptions will have to be justified fully in EISs on the overall US-EPA new-source NPDES program for the surface coal mining industry in West Virginia.

EPA's Position: EPA's environmentally protective regulatory activities are subject to NEPA only on a voluntary basis. If and when EPA proposes a criteria for screening new source mine applications, EPA will decide if an EIS will be prepared.

1E

EXECUTIVE SUMMARY

This report was prepared to assist US-EPA III as it extends its regulatory purview to the West Virginia surface coal mining industry under the National Pollutant Discharge Elimination System (NPDES) established by the Federal Water Pollution Control Act Amendments of 1972 (FWPCA, P.L. 92-500). It (1) describes existing conditions and trends in the surface coal mining industry, (2) identifies known environmentally sensitive resources throughout the State, (3) comments on the probable future flow of applications for new-source NPDES permits and on policy alternatives which must be specified by US-EPA as the new program is implemented, and (4) presents the conclusions and recommendations of the consultant to US-EPA Region III for implementation of the NPDES program.

West Virginia coal is mined by surface methods in 29 counties, and 7 additional counties have surface minable reserves. The mining activity can be grouped into five subregions, which in turn can be further subdivided by drainage basins. About 12% of employment in the West Virginia bituminous coal industry is in surface mining, which accounts for about 20% of State coal tonnage. The West Virginia Department of Natural Resources annually issues from 100 to 300 mining permits to the surface mining industry. All of these new-source mine operations apparently will need NPDES permits as soon as new-source discharge regulations are proposed by US-EPA for the industry in the Federal Register. Most of the applications (about 90%) will be for mines that produce less than 100,000 tons of coal per year, and fewer than 10 applicants annually will propose to mine more than 200,000 tons per year. During recent years the State of West Virginia has made increasing efforts to enforce State regulations that apply to planning, mining, and reclamation by the surface mining industry. Regulatory scrutiny of the industry will be essential in the future, as surface mines are opened at increasingly high elevations and on steeper and steeper slopes.

Sensitive resources that in the past have been and in the future may be affected adversely by surface coal mining in West Virginia are present throughout the mining regions. They include cultural, biological, agricultural, and geological resources. The Federal mandates for protection of these resources, for interagency coordination, and for public involvement are more comprehensive than those entailed by current West Virginia laws.

US-EPA policies and procedures governing NEPA review of new-source NPDES permit applications from the mining industry have not yet been finalized. Of special importance is the decision whether or not to establish minimum tonnage production thresholds for identifying mines subject to forthcoming Best Practices guidelines and to routine detailed NEPA review. Because the new-source NPDES program will be administered in accordance with the National Environmental Policy Act of 1969 (P.L. 91-190), alternative types of environmental impact statements (EISs)-- areawide, individual-mine -- are discussed, together with areawide in-house environmental reviews. The alternatives for delineating areawide study areas are outlined, and priorities for inventory and analysis of recommended areas are suggested. Interagency coordination activities based on Federal mandates other than NEPA also are described for the West Virginia surface coal mining industry, and issues related to information routinely required from applicants and to public involvement are noted.

The conclusions drawn by the consultant from this report are that US-EPA Region III should (1) initiate areawide environmental assessments, (2) acquire the authority to recover costs of processing applications (including NEPA reviews and EISs) from applicants, and in the interim develop individual-mine EISs by third-party agreements whenever possible, (3) routinely require sufficient information from applicants to facilitate US-EPA environmental reviews and incorporate such data into ongoing areawide inventories, (4) develop a geographically tailored regulatory strategy based on the varying environmental conditions within West Virginia, (5) apply the several non-NEPA coordination requirements to previously unmined land in the current backlog of existing-source surface mining NPDES permit applications, (6) coordinate the regulatory strategy developed for areawide assessments of the surface mining industry with regulatory strategy for deep mines and other point and nonpoint sources of pollutants, (7) avoid duplicating the regulatory effort of other agencies, and (8) consider carefully the resources that will be needed for enforcement of NPDES regulations and permit conditions in West Virginia.

Implementation of the proposed new-source NPDES program for the West Virginia surface coal mining industry will require a major and sustained effort on the part of US-EPA Region III, if a conscientious effort is made to comply with NEPA and other Federal environmental legislation. Areawide environmental inventories at the localized geographical scale necessary to regulate the surface coal mining industry will never be complete. Because such inventories are both costly and time-consuming to develop, US-EPA should consider the careful design of an ongoing environmental inventory system which provides the minimum information essential to US-EPA in assuring water quality pursuant to FWPCA, but avoids duplication of effort by other agencies and organizations.

An appendix outlines current permit applications and surface mining reports used by the West Virginia Department of Natural Resources and US-EPA Region III.

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GENERAL INTRODUCTION

This report was prepared to assist Region III, US-EPA, Philadelphia, Pennsylvania, to implement its environmental impact review responsibilities for new-source NPDES permits as applied to the surface coal mining industry in the State of West Virginia. West Virginia is the only State in Region III which does not (or will not during the near future) administer an approved NPDES program.[1]

The National Environmental Policy Act of 1969 (NEPA, 42 USC 4321 et seq.) was implemented by Executive Order 11514 of 5 March 1970, and the Council on Environmental Quality's (CEQ's)1973 (40 CFR 1500) Guidelines. These regulations require that all agencies of the Federal Government review major Federal actions, including the issuance of permits, and prepare detailed environmental statements on proposed actions which significantly will affect the quality of the human environment. The objectives of NEPA are to build into the agency decision-making process an appropriate and careful consideration of all environmental aspects of proposed actions, explain potential environmental effects of proposed actions and their alternatives for public understanding and comment, avoid or minimize adverse effects of proposed actions, and restore or enhance environmental quality as much as possible. Section 511.c.1. of the Federal Water Pollution Control Act as amended (FWPCA, P.L. 92-500) authorizes the Administrator to apply NEPA to the issuance of a permit under Section 402 for the discharge of any pollutant by a new source as defined in Section 306.

The discharge of a pollutant (defined in Section 502.12 of the FWPCA) means an addition of any pollutant to the waters of the United States.[2] Regulations for environmental review of Federally administered new-source NPDES permit applications under NEPA and other Federal statutes were published on 11 January 1977 (40 CFR 6; 42 FR 2450-2459). Those regulations, together with in-house drafts of related US-EPA regulations, provide the framework on which this report was developed.

As has been noted by US-EPA (41 FR 19387, 13 May 1976), the wastewater situation evident in the mining segment of the coal industry is unlike that encountered in most other industries. Water enters mines via precipitation, groundwater infiltration, and runoff. It may become polluted by contact with materials in the coal, overburden, spoil, or mine bottom. Except for dust control and fire protection, water is not used in the actual mining of coal in the United States at the present time. Wastewater handling and management are required and are a part of most coal mining methods or systems to insure the continuance of the mining operation during rainy periods and to improve the efficiency of the mining operation generally.

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[1] Specific language in the current State statute that must be revised before the NPDES permit program can be delegated to West Virginia was identified to the State by US-EPA early in 1976 (By letter, S. R. Wassersug, Director, Enforcement Division, US-EPA Region III to J. H. Hall, Chief, Division of Water Resources, WV-DNR, 6 February 1976). As of early 1977, the West Virginia Legislature had not revised the Water Pollution Control Act (West Virginia Code 20-5A, amended December 1974) to conform to the 1972 requirements of FWPCA (P.L. 92-500).

[2] The actual language of the FWPCA is "navigable waters", a term which has been broadened to include virtually any waters of the Nation by various court decisions (US-EPA 1976f).

This wastewater is discharged from a mine as mine drainage. Mine drainage may be polluted and require treatment before it can be discharged to streams. The quality of wastewater from the actual mining and from the coal storage, refuse storage, and coal preparation ancillary areas of the coal mining industry essentially is unrelated to production quantities.

In addition to handling and treating often massive volumes of wastewater during actual mining operations or coal loading, coal mine operators are faced with the same burden during idle periods. Mine drainage also may continue indefinitely after all mining operations have ceased, if proper mining methods and control technology are not employed, or even increase in intensity after mine closure if proper mine reclamation technology is not employed.

This report is divided into four major sections. First, the surface coal mining industry in West Virginia is described, the location of currently active and future mines is outlined, and the flow rate of permit applications is estimated. In the second section the areas known to be sensitive to potential environmental disruption in West Virginia are described and depicted on maps; data gaps are identified; and sources for updated information are listed. The third section outlines issues, alternatives, and problems which must be faced by US-EPA as it undertakes timely environmental reviews of new-source NPDES applications from the West Virginia surface coal mining industry. Finally, the fourth section presents the conclusions and recommendations of the consultant for consideration by US-EPA as its regulatory procedures are formulated.

I. SURFACE MINABLE COAL RESOURCES IN WEST VIRGINIA

Introduction

West Virginia is a major coal-producing State. During 1975 the total tonnage produced was about 109 million tons of bituminous coal, and only the production from Kentucky among 25 mining States exceeded that of West Virginia (WVCA 1976). About 19% of the total West Virginia production (20.6 million tons) was produced by surface techniques (Table 1). Production from surface mines in West Virginia was exceeded only in Kentucky, Indiana, Ohio, and Pennsylvania during 1975. During 1974 West Virginia coal made up 48% of the Nation's coal exports (WV-DOC 1976).

Surface mining is expected to continue to be a significant contributor of coal production in the future. Of the 39,590 million tons of reserves[1] that have been estimated in West Virginia, 5,212 million tons (13%) are estimated to be available for surface mining by current techniques (WVCA 1976).

Surface mining during the period 1977-1980 will be conducted in approximately 29 counties in West Virginia (Figure 1). New surface mines currently are prohibited by the West Virginia Legislature in 22 counties. It has been the practice of the Legislature to renew the moratorium for two-year periods, and the next renewal is required during the current (1977) session. Four counties not under legislative moratorium (Cabell, Putnam, Wayne, and Summers) have no significant coal production from surface mines.

Most of the land subject to mining has slopes greater than 25%. Slope in itself is not a limitation on the feasibility of surface mining in West Virginia, but it strongly influences the potential for adverse effects of mining on the environment. A longstanding practice in West Virginia is for mining operations to follow the coal seams along the contour of the mountains. Top-of-mountain surface mining is becoming more common in southern counties where slopes are steep. Where overburden depths are too great to justify surface mining operations or where the coal seam is highly weathered near the surface, the same coal seams as are mined elsewhere by surface methods may be mined by underground methods. Augering typically is used at the base of the surface-mine highwall to extract coal for distances of as much as 250 feet beyond the highwall.

The marketability of West Virginia coal is controlled by economics, and relative coal prices are governed in large part by the sulfur content and other properties of coals which determine their end use potential. Prices are affected only secondarily by the distance of the coal mine from rail or water transportation facilities. Most West Virginia coal (70%) is consumed by power plants. Coke and gas plants

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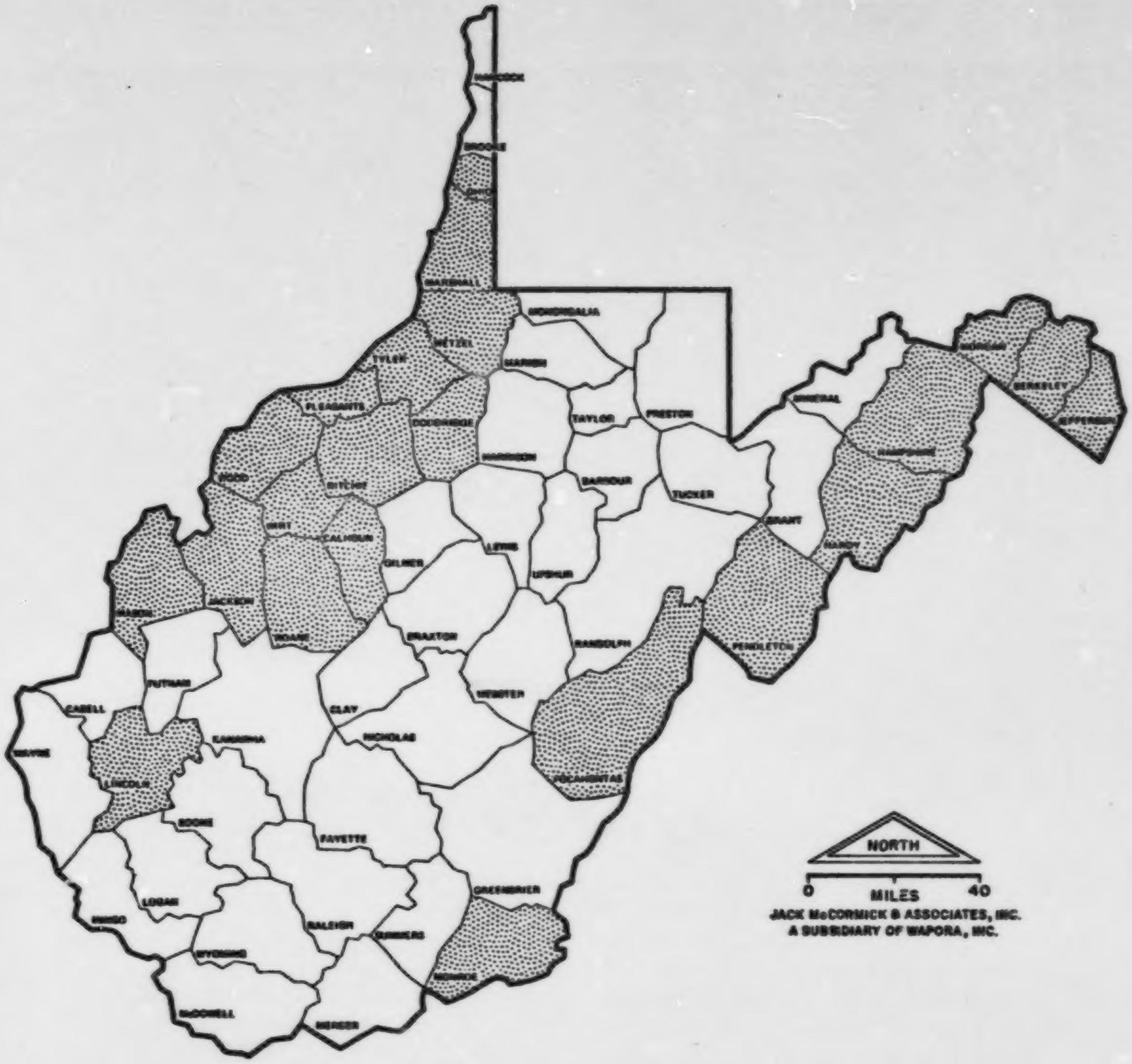
[1] Reserve herein is defined as the in-place coal that is technically and economically minable at this time. It is not a fixed quantity, but changes as new technology develops, as mining occurs, or as coal economics changes.

Table 1 . Coal production by method and by county in West Virginia 1975 (WVDM 1975). Data are short tons. An asterisk (*) denotes surface mining moratorium counties.

COUNTY	UNDERGROUND	SURFACE	TOTAL
Barbour	1,226,130	2,474,455	3,700,585
Boone	7,790,109	1,868,302	9,658,411
Braxton	21,455	66,882	88,337
Brooke	653,219	86,125	739,344
Clay	69,176	-	69,176
Fayette	2,296,113	564,080	2,860,193
Gilmer	33,692	85,693	119,385
Grant	1,476,925	343,029	1,819,954
Greenbrier	330,293	539,768	870,061
Harrison	3,294,806	1,138,997	4,433,803
Kanawha	5,422,861	2,386,901	7,809,762
Lewis	50,040	664,356	714,396
*Lincoln	33,313	-	33,313
Logan	7,297,567	928,095	8,225,662
McDowell	10,099,208	758,162	10,857,370
Marion	5,487,285	30,366	5,517,651
*Marshall	5,265,921	-	5,265,921
*Mason	294,927	-	294,927
Mercer	947,725	28,497	976,222
Mineral	11,028	318,016	329,044
Mingo	4,012,069	55,019	4,567,088
Monongalia	10,088,208	967,815	11,056,023
Nicholas	4,335,036	1,271,766	5,606,802
*Ohio	1,411,824	-	1,411,824
Preston	815,475	1,732,605	2,548,080
Raleigh	5,438,393	825,890	6,264,283
Randolph	196,771	691,668	888,439
Summers	80,386	-	80,386
Taylor	-	173,023	173,023
Tucker	-	357,040	357,040
Upshur	957,509	1,041,713	1,999,222
Wayne	547,886	-	547,886
Webster	177,027	266,182	443,209
Wyoming	8,252,443	469,633	8,722,076
TOTAL	88,414,820	20,634,078	109,048,898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CABELL
CLAY
KANAWHA
NICHOLAS
WAYNE
LINCOLN
POCAHONTAS
BOONE
FAYETTE
NORTH
0
MILES
40
JACK McCORMICK & ASSOCIATES, INC.
A SUBSIDIARY OF WAPORA, INC.
GREENBRIER
LOGAN
MINGO
RALEIGH
SUMMERS
WYOMING
MONROE
McDOWELL
MERCER

Figure 1. Surface coalmine moratorium Counties (stippled) in West Virginia, 1976.

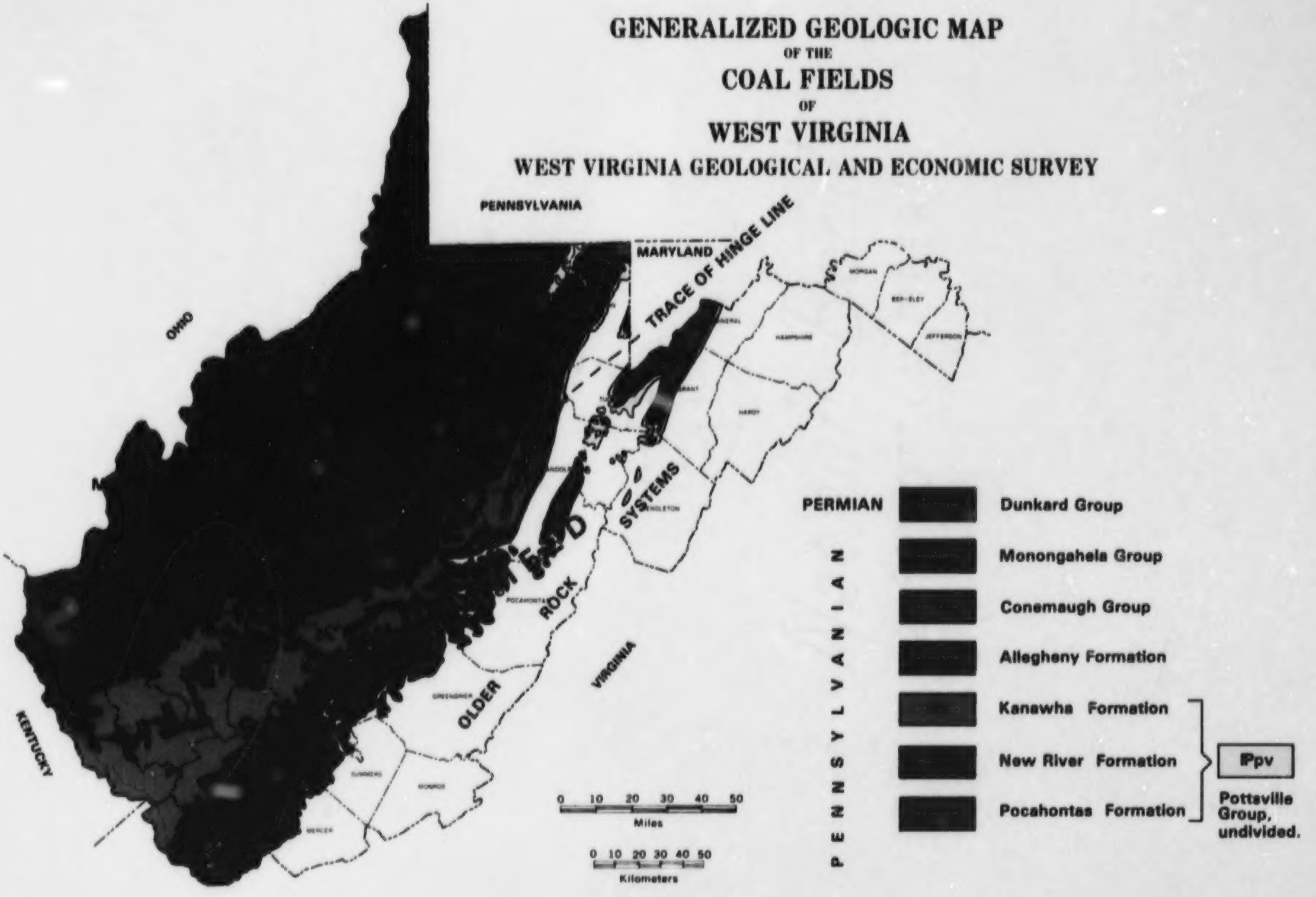
consume 15%; other industrial uses, 15%. More of the high-quality coal from southern West Virginia is consumed by coke and gas plants (32%) and other industrial uses (21%) than by power plants (30%).

Low sulfur (less than 1.5% S) coal generally is found in the southern section; medium sulfur coal (1.5 to 3.0% S), in the north-central section; and high sulfur coal (3.0% S or more), in the northeastern section of West Virginia (Figure 2). Of 2,118 million tons of strippable reserves, 54% is low sulfur, 31% is medium sulfur, and 15% is high sulfur coal. Low sulfur coal is more readily marketed than high sulfur coal, because high sulfur coal cannot be burned under existing technology within emissions limitations designed to protect air quality and because significant quantities of low sulfur coals are used for metallurgical purposes. High sulfur coal typically is blended with low sulfur coal to meet air quality standards. Metallurgical coals command the highest market prices.

Through 1980 it is expected that surface mining will focus on the 1,138 million-ton reserves of strippable low-sulfur coal in West Virginia, which are found in the 28 beds situated in 20 central and southern counties. Sixteen of the surface minable coalbeds contain only low sulfur coal; the other 12 beds contain coal of variable sulfur content. The 16 coalbeds that have only low-sulfur coal contain 53% of the West Virginia total low-sulfur bituminous coal reserves. Four coalbeds -- the Lower Kittanning (203 million tons), the Stockton (115 million tons), the Coalburg (216 million tons), and the Winifrede (128 million tons) -- contain 58% of the low-sulfur reserves, in addition to medium- and high-sulfur reserves. These four coalbeds crop out and are available for strip mining in 13 central and southern counties of the State. In the south, Boone County has the largest reserves of low-sulfur coal estimated at 275 million tons, followed by Mingo, Logan, Raleigh, and Kanawha Counties at 146, 124, 109, and 103 million tons, respectively. These five counties have over 66% of the State's low-sulfur reserves. The Pocahontas group of all low-sulfur coalbeds contains an estimated 81 million tons of available strippable coal concentrated in six southern counties: Fayette, Greenbrier, McDowell, Mercer, Raleigh, and Wyoming.

Because only 13% of the West Virginia coal is consumed within the State, long distance transportation is important for coal marketing. Trucks economically can move coal only relatively short distances to rail and barge terminals. Because only the lower reaches of the Kanawha, Monongahela, and Ohio Rivers can accommodate barges, rail is the major long-distance transport mode, and all areas where increased strip mining is anticipated through 1980 are within 20 miles of a rail spur.

GENERALIZED GEOLOGIC MAP
OF THE
COAL FIELDS
OF
WEST VIRGINIA
WEST VIRGINIA GEOLOGICAL AND ECONOMIC SURVEY


PENNSYLVANIA
MARYLAND
OHIO
KENTUCKY
VIRGINIA
TRACE OF HINGE LINE
OLDER ROCK SYSTEMS
MORGAN
BERKELEY
JEFFERSON
MINERAL
HAMPSHIRE
GRANT
HARDY
PENDLETON
POCAHONTAS
GREENBRIER
SUMMERS
MONROE
MERCER
PERMIAN
Dunkard Group
PENNSYLVANIAN
Monongahela Group
Conemaugh Group
Allegheny Formation
Kanawha Formation
New River Formation
Pocahontas Formation
IPpv
Pottsville Group, undivided.
0 10 20 30 40 50
Miles
0 10 20 30 40 50
Kilometers

1

The locations of coal cleaning plants do not affect current surface mining operations. Coal from small mines (less than 100,000 tons per year) generally is moved from mines by truck to cleaning plants run by large mine operators prior to long-distance shipment. Portable cleaning plants are moved from mine to mine where quantities of coal mined are sufficient to warrant an individual coal-cleaning plant. Because most new activity is expected to be in the same areas as current surface mining operations, the locations of extant coal cleaning plants will not affect surface mining through 1980.

The coal industry's contribution to the West Virginia economy has been increasing, although total tonnage has declined during the mid 1970's. During 1974 the bituminous coal mining industry employed more than 48,000 persons (9% of the total West Virginia labor force) and provided $786 million in personal income (13% of the State total; WV-DOC 1976). Almost 12% of the 55,256 persons employed in coal mining during 1975 were working for surface mines (WVDM 1975b).

Geographic Distribution and Geologic Occurrence of Surface Minable Coal in West Virginia

The coal measures of West Virginia occur in the Pennsylvanian and Permian sediments that occupy a considerable part of West Virginia (Figure 2). Surface-minable coal occurs in all nonmoratorium counties (Figure 1), as well as in Mason, Lincoln, Ohio, and Pocahontas Counties (where surface mining of coal currently is restricted).

The coal measures of West Virginia are situated entirely within the Appalachian Plateau, which is formed by gently folded or flat Paleozoic age sedimentary rocks that dip regionally toward the northwest. Consequently, younger rocks and younger coal seams are exposed in northwestern West Virginia than in southeastern West Virginia. The combined maximum thickness of these rock formations is about 6,570 feet. In ascending order the major formations are the Pocahontas Formation (720 feet), the New River Formation (1,030 feet), the Kanawha Formation (2,100 feet), the Allegheny Formation (330 feet), the Conemaugh Group (410 feet), and the Dunkard Group (1,180 feet).

As shown in Figure 2, the coal measures can be divided into a Northern Coalfield and a Southern Coalfield. The boundary between these two coalfields is formed by a geological hinge line that is oriented northeast-southwest as shown on Figure 2. The coals in the Southern Coalfield generally are low in sulfur (<1.5%) and ash (<6%). They include low-volatile, metallurgical-grade, coking coals. These older coals of the Pocahontas, New River, and Allegheny Formations become thinner in a northern direction and are noneconomic in the Northern Coalfield. The coals of the Northern Coalfield generally are high in sulfur (>1.5%) and ash (>6%). They also are high volatile coals, and they are utilized for steam generation. Some of the northern seams contain more than 3% sulfur, and the coal must be mixed with low sulfur coals to meet air quality compliance standards.

Current Production

Of the 117 named coal seams in West Virginia, 62 are minable (Lotz 1970). Forty of the 62 seams produced coal by surface mining operations during 1975 (Table 2). Production from 12 of them (Waynesburg, Redstone, Pittsburgh, Elk Lick, Bakerstown, Freeport (2), Kittannings (3), Stockton-Lewiston, and Sewell) exceeded 500,000 tons during 1975, and their combined production was about 17 million tons (82% of the total produced by surface mines; data from US Bureau of Mines).

Production data and numbers of small and large mines from 1971 to 1975 are summarized in Table 3. The total number of operating mines and the production of coal have ranged from 356 mines and 19.6 million tons in 1974 to 525 mines and 25.4 million tons in 1971. Production (from about 466 mines) during 1976 is expected to have been slightly greater than 1975 production. During the first 11 months of 1976, production exceeded the 11-month 1975 production by slightly more than 100,000 tons (WVDM, file data).

The location of 466 mines operating during October 1976 is shown in Figure 3. The probable extent of surface minable coal also is shown and is considered to be inclusive rather than exclusive of areas in West Virginia that may be subject to extensive surface mining. The area indicated on Figure 3 was based on geologic considerations and was confirmed by interviews with Messrs. Thomas Arkle (West Virginia Geological Survey), John Sturm (West Virginia Surface Coal Mining Association), and Patrick Parks (West Virginia Division of Reclamation) during January 1977.

Production of surface-mined coal is greatest in two general regions of West Virginia (Figure 4): (1) a northern area (Preston, Barbour, Upshur, Lewis, Harrison, and Monongalia Counties); and (2) a southern area (Nicholas, Kanawha, Boone, Logan, Fayette, Greenbrier, Raleigh, Wyoming, Mingo, and McDowell Counties). This regional distribution of production has occurred in West Virginia at least since 1971, and it is expected to remain about the same in the near future. Production in the central part of the State may increase.

The number of permits issued by the West Virginia Division of Reclamation during recent years is indicated in Table 4. The maximum number of permits issued was 616 during 1970. This peak resulted from two factors: (1) unemployment of coal miners subsequent to the maximum production during 1968 resulted in a large number of permit applications for very small operations by unemployed miners, and (2) large companies were willing to purchase and process (clean) small quantities of coal from a large number of operators (Verbal communication, 12 October 1976, Mr. Thomas Arkle, West Virginia Geological Survey). These conditions no longer exist and are not expected to recur, so relative stability with a slow increase in the number of permit applications can be expected during the 1977-1980 period.

Table 2. Minable coal seams in West Virginia (Lotz 1970). Seams are listed in order of geologic age. Seams marked with an asterisk were mined by surface methods during 1975 (data from US Bureau of Mines).

Coal Seam	Geologic Unit	Age
Washington	Dunkard Group	Permian
*Waynesburg		
Uniontown	Monongahela Group	Pennsylvanian
*Sewickley		
*Redstone		
*Pittsburgh		
Little Pittsburgh	Conemaugh Group	
Little Clarksburg		
*Elk Lick		
*Harlem		
Upper Bakerstown		
*Bakerstown		
Brush Creek		
*Mahoning		
*Upper Freeport		
*Lower Freeport	Allegheny Formation	
*Upper Kittanning		
*Middle Kittanning		
*Lower Kittanning		
Clarion		
Upper Mercer	Kanawha Formation	
*Stockton-Lewiston		
*Coalburg		
Buffalo Creek		
*Winifrede		
Chilton "A"		
*Chilton		
*Hernshaw		
Dingess		
Williamson		
*Cedar Grove		
*Lower Cedar Grove		
*Alma		
*Peerless		
*No. 2 Gas		
*Powellton		
Matewan		
*Eagle		
*Bens Creek		
Little Eagle		
Cedar		
Lower War Eagle		
*Glenalum Tunnel		
*Gilbert		
*Douglas		
Lower Douglas		

Table 2. Minable coal seams in West Virginia (concluded).

Coal Seam	Geologic Unit	Age
*Bradshaw	New River Formation	Pennsylvanian
Castle		
Sewell "B"		
*Sewell		
*Welch		
Little Raleigh		
*Beckley		
*Fire Creek		
*No. 9 Pocahontas		
No. 8 Pocahontas		
*No. 7 Pocahontas	Pocahontas Formation	
*No. 6 Pocahontas		
*No. 5 Pocahontas		
*No. 4 Pocahontas		
*No. 3 Pocahontas		
No. 2 Pocahontas		

Table 3. Number and size of surface coal mines, and total surface production, by counties, in West Virginia (data from US Bureau of Mines).

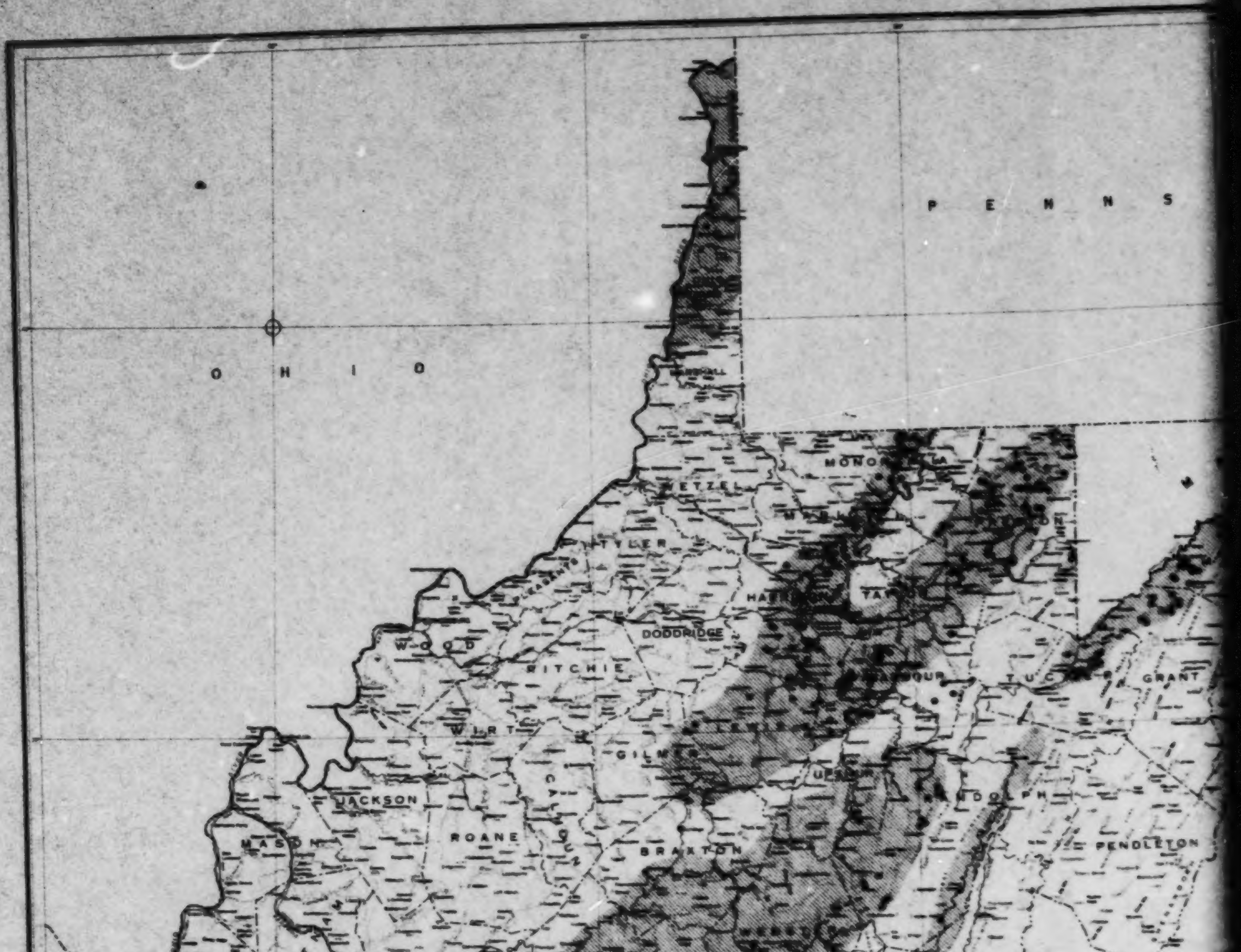
	1971				1972				1973				1974				1975			
COUNTY	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Barbour	2,457	24	7	31	2,478	24	5	29	3,192	20	11	31	2,651	29	9	38	2,436	19	10	29
Boone	2,778	51	6	57	2,012	49	5	54	2,221	15	7	22	1,617	19	4	23	1,868	15	8	23
Braxton	22	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	67	3	0	3
Brooke	283	7	1	8	220	7	1	8	142	4	0	4	98	3	0	3	86	4	0	4
Clay	74	1	0	1	4	1	0	1	0	0	0	0	22	1	0	1	0	0	0	0
Fayette	1,125	22	4	26	649	20	1	21	911	23	2	25	539	18	0	18	555	20	0	20
Gilmer	79	2	0	2	50	1	0	1	0	0	0	0	65	1	0	1	86	1	0	1
Grant	612	8	1	9	486	7	1	8	201	2	1	3	307	10	1	11	344	10	0	10
Greenbrier	188	1	1	2	455	9	2	11	260	5	1	6	370	13	1	14	539	16	1	17
Harrison	1,244	25	2	27	1,358	27	4	31	779	13	1	14	802	19	2	21	1,124	34	1	35
Kanawha	3,450	52	7	59	3,703	54	11	65	2,455	42	6	48	2,643	21	10	31	2,384	30	5	35
Lewis	541	18	0	18	393	9	2	11	250	22	0	22	581	16	1	17	664	19	1	20
Logan	1,771	40	3	43	1,053	13	3	16	990	12	5	17	824	7	4	11	928	11	4	15
Marion	147	3	1	4	95	5	0	5	20	2	0	2	0	0	0	0	29	3	0	3
McDowell	1,081	36	3	39	848	26	2	28	696	16	2	18	349	11	1	12	756	12	3	15
Mercer	83	5	0	5	90	7	0	7	71	9	0	9	54	4	0	4	29	3	0	3
Mineral	265	8	1	9	211	4	0	4	251	3	1	4	312	8	0	8	317	14	0	14
Mingo	1,471	35	1	36	999	25	1	26	519	14	2	16	477	2	3	5	554	11	0	11
Monongalia	432	12	0	12	635	13	1	14	988	7	3	10	1,051	8	3	11	963	10	4	14
Nicholas	926	13	2	15	1,316	22	3	25	1,274	22	5	27	1,438	16	7	23	1,271	23	5	28
Preston	1,265	14	3	17	970	25	2	27	874	16	4	20	1,997	31	6	37	1,734	44	4	48
Raleigh	1,779	28	5	33	1,231	22	3	25	813	14	1	15	576	14	1	15	811	22	1	23
Randolph	521	8	2	10	676	8	3	11	757	14	3	17	818	8	2	10	689	13	1	14
Taylor	192	6	1	7	288	4	1	5	152	4	0	4	95	3	0	3	171	10	0	10
Tucker	376	1	2	3	143	1	1	2	180	1	1	2	307	2	2	4	358	9	1	10
Upshur	885	16	2	18	625	12	2	14	905	7	4	11	1,042	17	3	20	1,043	20	4	24
Webster	51	3	0	3	17	4	0	4	166	2	1	3	183	2	1	3	267	9	1	10
Wyoming	1,287	27	3	30	800	17	1	18	532	17	1	18	392	11	1	12	471	11	0	11
TOTAL	25,385	467 (89%)	58 (11%)	525	21,805	416 (89%)	55 (11%)	471	19,599	306 (83%)	62 (17%)	368	19,610	294 (82%)	62 (18%)	356	20,544	396 (88%)	54 (12%)	450

A:Tons (000's)

B:# Mines <100,000 tons/yr

C: # Mines ≥100,000 tons/yr

D: Total # Mines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TAY
LEWIS
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JACKSON
MASON
ROANE
BRAXTON
RANDOLPH
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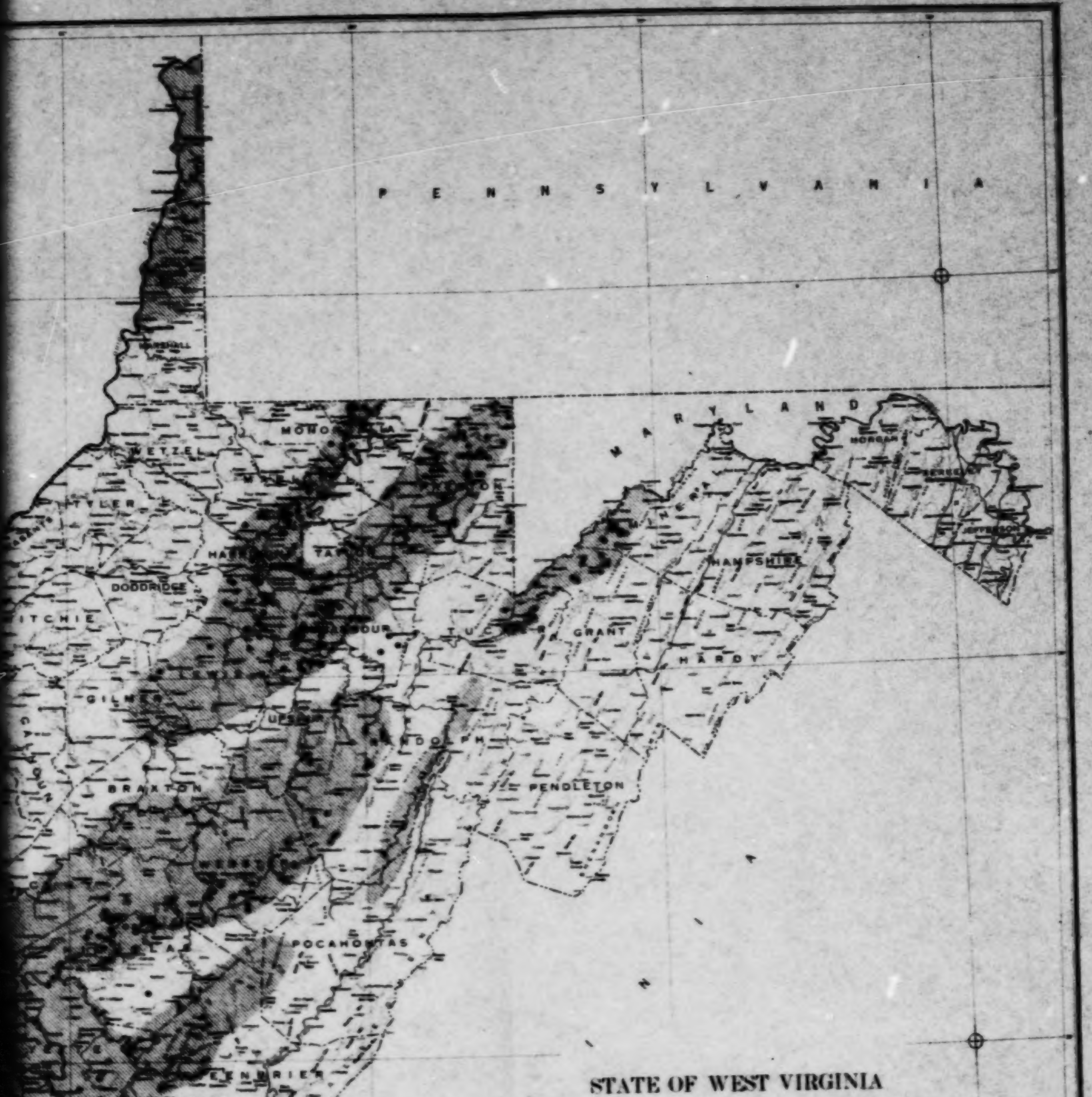
SURFACE
• ACTIVE S

A

13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BRAXTON
TAYLOR
TUCKER
GRANT
HARDY
HAMPSHIRE
MORGAN
JEFFERSON
UPSHUR
RANDOLPH
PENDLETON
POCAHONTAS
SUMMERS
MONROE

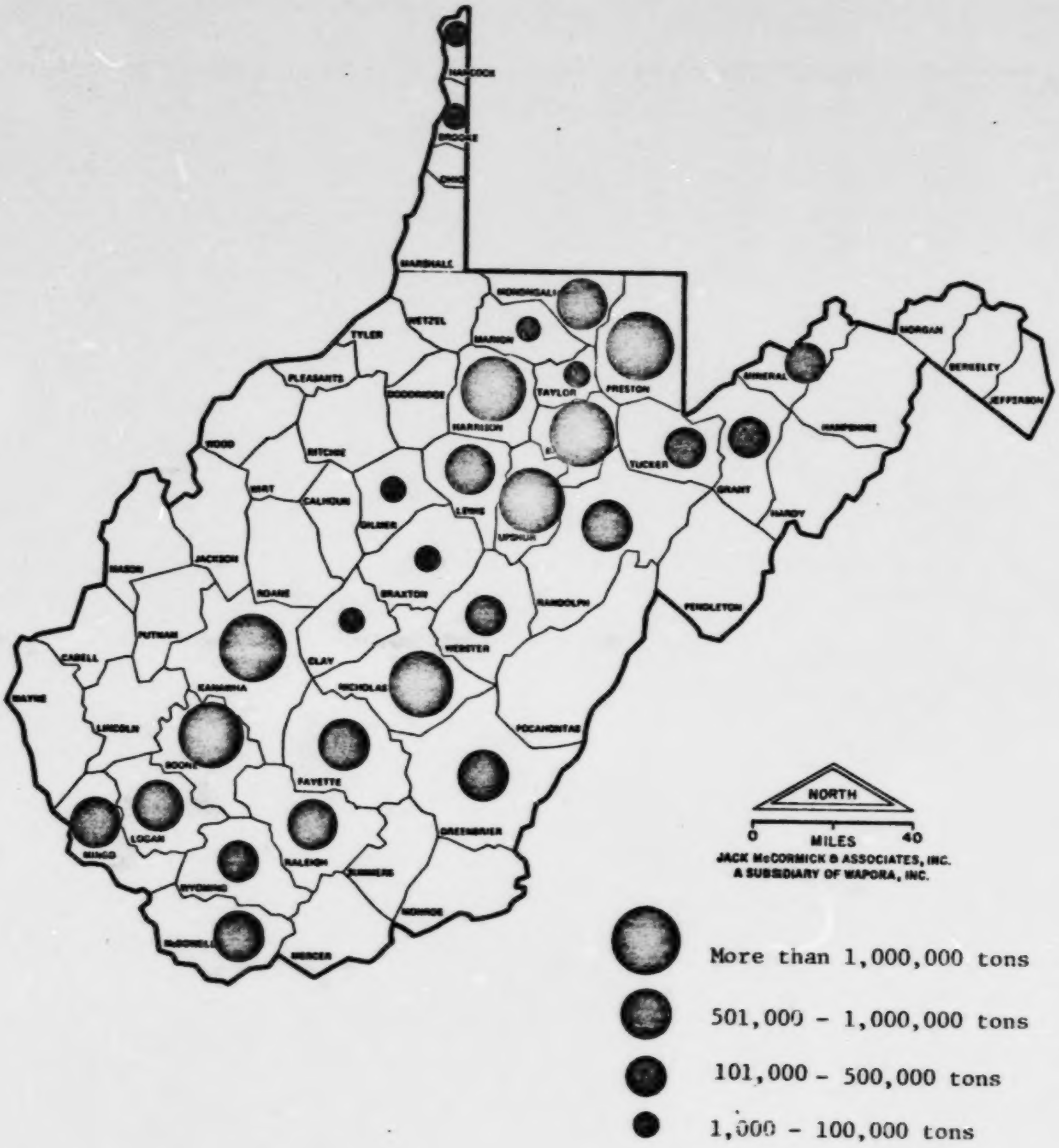
STATE OF WEST VIRGINIA

SURFACE COAL MINING AREAS

• ACTIVE SURFACE MINE, 1976.

FIGURE 3

B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HARRISON
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PRESTON
WOOD
RITCHIE
WIRT
CALHOUN
GILMER
LEWIS
UPSHUR
TUCKER
MINERAL
GRANT
HAMPSHIRE
HARDY
MORGAN
BERKELEY
JEFFERSON
MASON
JACKSON
ROANE
BRAXTON
RANDOLPH
PENDLETON
PUTNAM
CABELL
CLAY
WEBSTER
NICHOLAS
WAYNE
KANAWHA
LINCOLN
BOONE
POCAHONTAS
FAYETTE
GREENBRIER
MINGO
LOGAN
RALEIGH
SUMMERS
WYOMING
MONROE
McDOWELL
MERCER
NORTH
0 MILES 40
JACK McCORMICK & ASSOCIATES, INC.
A SUBSIDIARY OF WAPORA, INC.
More than 1,000,000 tons
501,000 - 1,000,000 tons
101,000 - 500,000 tons
1,000 - 100,000 tons

Figure 4. 1975 West Virginia surface mine production, by counties.

The number of surface mining permits issued by the Division of Reclamation is considered to be a good approximation of the number of NPDES mining applications that will be made to US-EPA (Table 4). From 1972 to 1976 there was an 11% increase (from 246 to 278 permits). It is expected that 250 to 300 State mining permits will be issued per year through 1980 (Verbally, Mr. Benjamin Green, Director, and Mr. Roger Hall, West Virginia Division of Reclamation, 6, 12, 24 October and 24 November 1976). It is probable that the number of prospecting permit applications will range between 150 and 300 annually.

A summary of the number of permits and permitted acreage from 1972 to 1975 is given by counties in Table 5. A comparison of production by County (Table 3) and total permitted acreage by County (Table 5) shows that (1) a correlation exists between permitted acreage and production, and (2) that no great change in the relative permitted acreage or production between counties occurred from 1972 to 1975.

Figure 5, which depicts total acreage permitted during 1975, is similar in pattern to Figure 4, which depicts production. Because the 1975 total permitted acreage reflects near-term future production, and because there is a similarity between production and permitted acreage, most mining in the near future, probably will be concentrated in the northern and southern coalfields in the same general areas where mining currently is concentrated.

The size of surface mines in West Virginia varies from less than 10 acres to more than 1,000 acres. The mean acreage of permits in northern West Virginia is smaller than in southern West Virginia (Table 5, Figure 6). The mean size of permits in northern West Virginia is less than 80 acres, because large tracts of single ownership land are not common, and extensive stripping in the past has reduced the extent of unmined tracts.

The Probable Location of New Surface Coal Mines

The expected aggregate production and numbers of operating mines through 1980 are summarized by counties in Table 6. These projections were prepared by coal seam for each county on the basis of the following data:

1. The location of existing surface coal mines as mapped by WV-DNR as of October 1976.
2. Surface minable reserves.
3. Coal characteristics.
4. Information on surface mining activity in each county and county production by seams, 1971-1975.

Table 4 . Number and acreage of West Virginia prospecting permits, surface mining permits, and successful prosecutions, 1967-1976 (data from WV-DNR).

Year	Prospecting Permits			Surface Mining Permits[1]			Successful Prosecutions[2]
	Number Issued	Total Acreage	Mean Acreage	Number Issued	Total Acreage	Mean Acreage	
1967	7	556	8.0	94	4,150	44.1	5
1968	39	454	11.6	336	13,435	40.0	7
1969	65	659	10.1	400	15,711	39.3	6
1970	184	2,442	13.3	616	31,802	51.6	24
1971	95	1,553	16.3	343	30,000	87.5	125
1972	112	2,285	20.4	246	24,508	99.6	318
1973	125	2,002	16.0	241	20,587	85.4	245
1974	279	3,233	11.6	255	18,919	74.2	242
1975	209	2,756	13.2	272	16,966	62.4	327
1976	159	2,272	14.3	278	22,249	80.0	290

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[1] Includes permits for quarries. Permits for surface coal mines comprise 95 % or more of the surface mining permits.

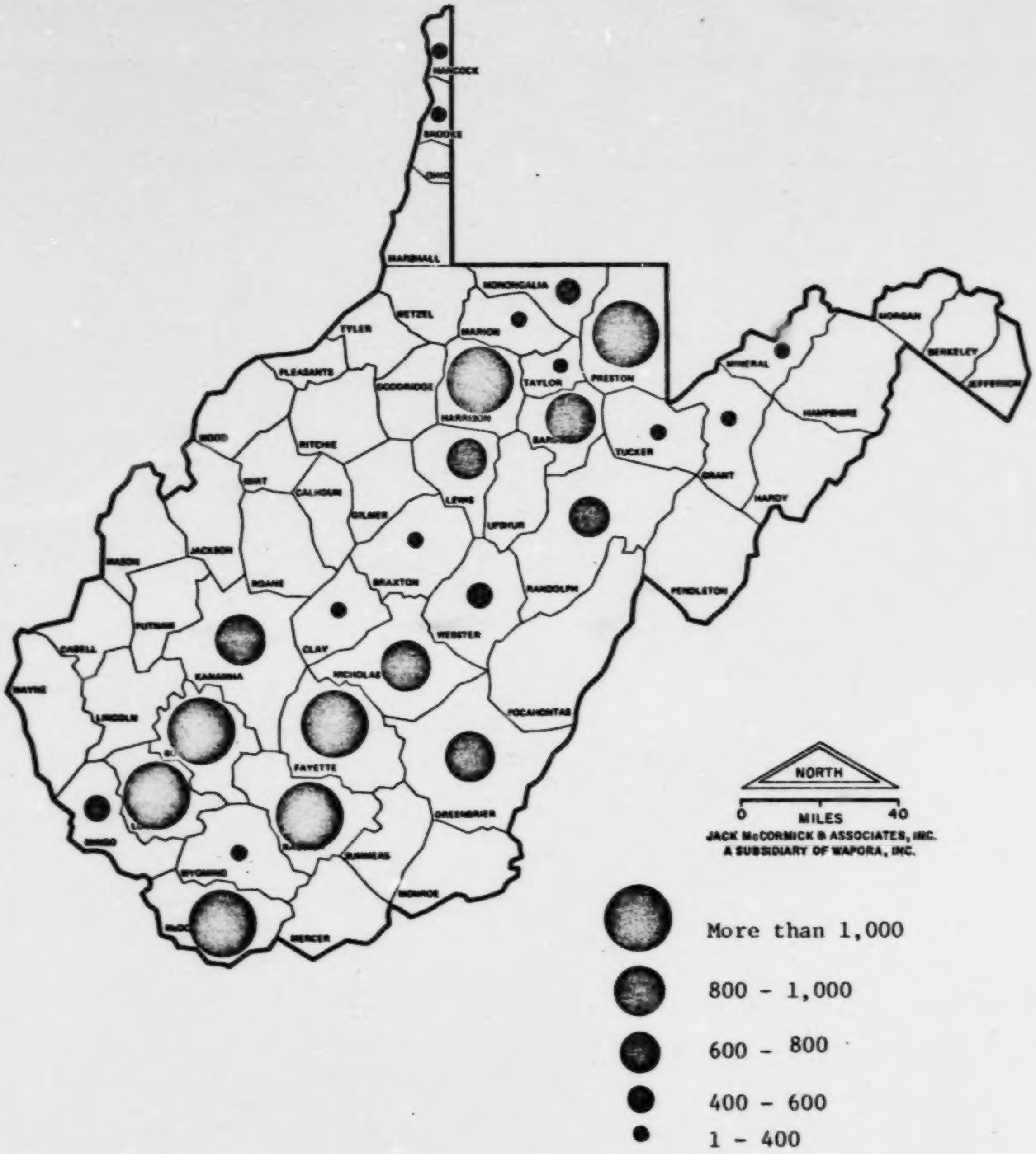
[2] Violations for which WV-DNR allegations of improper mining practices were judged to be proper and legal by State courts. No detailed breakdown of prosecutions by mine are available.

Table 5. West Virginia surface coal mining permits by counties, 1972 - 1975 (data from WV-DNR). Data are acres except as otherwise indicated.

	1972					1973					1974					1975				
COUNTY	No.	Max.	Min.	Mean	Total	No.	Max.	Min.	Mean	Total	No.	Max.	Min.	Mean	Total	No.	Max.	Min.	Mean	Total
Barbour	19	257	11	67	1285	11	241	13	79	796	17	95	4	41	701	12	270	11	68	816
Boone	17	450	27	135	2305	15	255	20	169	2543	9	205	30	118	1069	10	190	16	109	1087
Braxton	0	-	-	-	0	0	-	-	-	0	0	-	-	-	0	3	78	44	59	177
Brooke	1	-	-	20	20	3	85	13	45	135	1	-	-	14	14	4	66	25	45	95
Clay	1	-	-	50	50	1	-	-	15	15	4	50	16	29	116	3	55	10	32	95
Fayette	18	300	60	111	2000	9	500	25	153	1382	16	360	15	105	1695	15	350	3	86	1286
Gilmer	0	0	0	0	0	1	-	-	35	35	0	0	0	0	0	1	-	-	27	27
Grant	4	90	50	70	250	6	200	8	82	497	4	180	64	118	475	2	138	42	90	180
Greenbrier	11	400	13	109	1206	9	300	23	98	888	6	280	8	72	435	15	177	6	55	821
Hancock	0	-	-	-	0	1	-	-	106	106	0	-	-	-	0	0	-	-	-	0
Harrison	10	116	13	41	412	8	212	6	41	331	9	90	8	35	318	29	320	5	40	1163
Kanawha	28	250	8	90	2547	31	238	6	81	2517	24	150	6	53	1279	17	130	7	51	868
Lewis	1	-	-	17	17	9	169	3	56	511	12	110	15	52	631	8	162	34	84	669
Logan	16	342	50	155	2495	8	308	22	123	990	9	1156	10	227	2050	7	200	32	164	1148
McDowell	16	630	20	141	2271	13	500	13	86	1119	9	289	17	118	1066	8	510	31	159	1268
Marion	1	-	-	24	24	0	-	-	-	0	1	--	-	32	32	5	41	13	21	103
Mercer	3	120	50	78	235	4	197	25	97	391	-	-	-	47	47	0	-	-	0	0
Mineral	3	130	20	78	235	6	64	13	34	204	4	170	16	81	327	5	53	16	34	169
Mingo	15	225	30	120	1803	3	230	50	120	361	4	150	50	90	360	8	120	19	71	567
Monongalia	1	-	-	133	133	7	153	15	69	487	8	125	6	37	297	10	150	13	57	570
Nicholas	15	400	13	141	2126	12	728	12	120	1440	14	145	7	70	987	15	219	12	54	809
Preston	8	87	18	44	353	12	67	15	38	465	25	115	7	47	1179	27	175	15	53	1428
Raleigh	20	450	39	113	2269	13	163	20	78	1023	15	284	13	88	1333	17	275	15	68	1158

Table 5 . West Virginia surface coal mining permits by counties, 1972 - 1975 (concluded).

COUNTY	No.	Max.	Min.	Mean	Total	No.	Max.	Min.	Mean	Total	No.	Max.	Min.	Mean	Total	No.	Max.	Min.	Mean	Total
Randolph	6	85	30	51	310	8	80	20	38	310	11	94	7	48	529	8	230	14	79	633
Taylor	0	-	-	-	0	0	-	-	-	0	4	42	13	32	128	5	83	11	41	207
Tucker	3	72	13	20	62	4	190	13	63	254	5	50	13	36	181	2	73	36	54	109
Upshur	7	40	13	21	152	7	141	8	62	436	14	560	8	79	1112	11	45	13	29	318
Webster	4	79	21	41	165	3	80	21	49	148	2	-	-	50	100	7	102	14	46	459
Wyoming	13	311	25	121	1576	12	225	11	61	740	13	155	10	75	975	8	118	10	45	316
Total	241	-	-	101	24,331	216	-	-	84	18,101	240	-	-	84	20,076	262	-	-	63	16,546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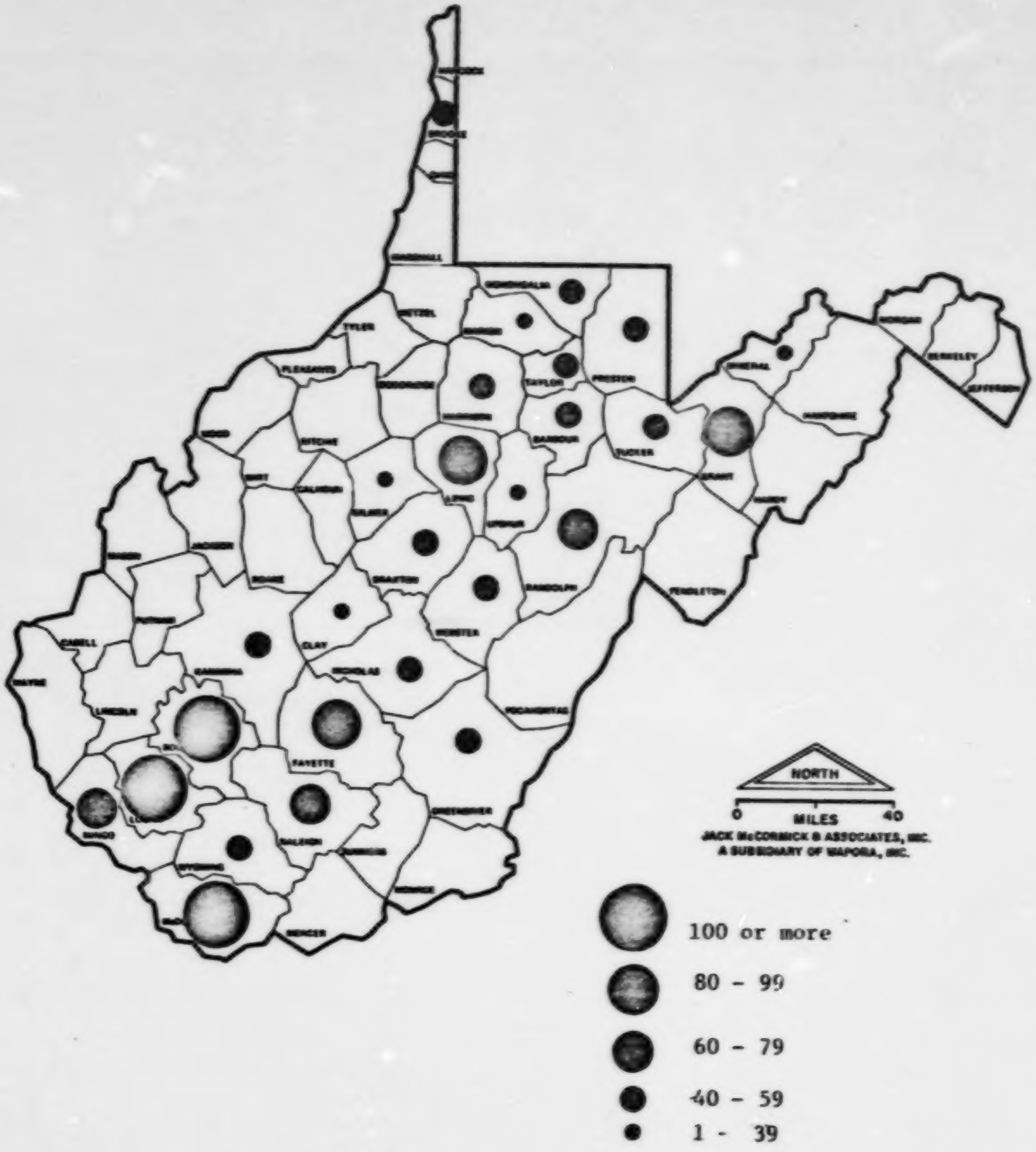
TUCKER
GRANT
HARDY
WIRT
CALHOUN
LEWIS
GILMER
UPSHUR
JACKSON
MASON
ROANE
BRAXTON
RANDOLPH
PENDLETON
PUTNAM
CLAY
WEBSTER
CABELL
KANAWHA
NICHOLAS
WAYNE
LINCOLN
POCAHONTAS
FAYETTE
GREENBRIER
MINGO
SUMMERS
WYOMING
MONROE
MERCER
NORTH
0
MILES
40
JACK McCORMICK & ASSOCIATES, INC.
A SUBSIDIARY OF WAPORA, INC.
More than 1,000
800 - 1,000
600 - 800
400 - 600
1 - 400

Figure 5. 1975 total acreage in which mining was permitted, by counties (data from WV-DNR).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WEBSTER
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KANAWHA
NICHOLAS
LINCOLN
POCAHONTAS
FAYETTE
GREENBRIER
MINGO
RALEIGH
SUMMERS
WYOMING
MONROE
MERCER
NORTH
0
MILES
40
JACK McCORMICK & ASSOCIATES, INC.
A SUBSIDIARY OF WAPORA, INC.
100 or more
80 - 99
60 - 79
40 - 59
1 - 39

Figure 6. 1975 mean acreage of surface mining permits, by counties (data from WV-DNR).

Table 6. Expected tonnage and number of surface coal mines, by counties, in West Virginia, 1977-1980, based on projected tonnage by coal seams. The projections were prepared by Urbdata, Inc. Greensburg PA, based on US Bureau of Mines data for individual coal seams and on knowledge of the West Virginia surface mining industry. Because surface mines are short-lived, there will be new mining applications even when the number of mines in a county is constant.

	Tons (000's)	Mines	Tons (000's)	Mines	Tons (000's)	Mines	Tons (000's)	Mines
COUNTY	1977		1978		1979		1980	
Barbour	2,350	34	2,300	34	2,100	34	2,200	33
Boone	1,920	25	2,010	26	2,060	27	2,120	27
Braxton	90	7	110	7	130	7	150	7
Brooke	80	4	80	4	80	4	80	4
Clay	50	3	100	4	140	4	160	5
Fayette	580	19	590	19	610	20	615	20
Gilmer	90	2	90	2	80	2	70	2
Grant	380	11	390	12	400	12	410	12
Greenbrier	590	18	770	21	965	25	1,095	18
Hancock	5	1	5	1	5	1	5	1
Harrison	1,080	23	1,060	23	1,040	23	1,020	21
Kanawha	2,480	34	2,500	34	2,530	35	2,580	35
Lewis	660	24	670	24	680	24	700	25
Logan	1,020	18	1,100	19	1,210	21	1,310	23
Marion	40	5	40	5	40	5	40	5
McDowell	665	14	665	14	665	14	665	14
Mercer	50	4	50	4	50	4	50	4
Mineral	220	12	235	15	235	13	235	13
Mingo	540	12	540	12	540	12	540	12
Monongalia	1,005	14	1,020	12	1,045	13	1,065	15
Nicholas	1,340	28	1,390	29	1,420	29	1,475	30
Preston	1,690	40	1,720	39	1,721	39	1,770	39
Raleigh	780	24	780	24	780	26	780	26
Randolph	650	14	680	16	680	15	660	13
Taylor	160	5	160	5	170	6	170	6
Tucker	310	11	330	13	370	14	400	15
Upshur	1,100	21	1,140	23	1,180	23	1,230	25
Webster	360	8	410	10	480	10	550	13
Wyoming	420	10	450	11	440	11	450	11
Total	20,705	445	21,385	462	21,846	473	22,595	484

The projections were made by Dr. J. H. Kelley of Urbdata Associates, Inc., with the assistance of T. Arkle, Jr., and O. VandeLinde. A breakdown of county mining activity, production data, and projections, by seams, was submitted to US-EPA in a preliminary draft of this report on 1 December 1976.

Total tonnage of surface mined coal is expected to increase by about 2 million tons (10%) from 1975 to 1980 (Table 7). The greatest decrease in production is expected to occur in northern West Virginia (Barbour, Harrison, Mineral, and Upshur Counties). Substantial declines in production also are expected in Raleigh and McDowell Counties in the southern part of the State. Substantial increases in production are projected to occur in the central and southern counties, where low-sulfur coals comprise the greatest proportion of surface minable reserves.

Surface Mine Regions of West Virginia

To facilitate a regional review of selected characteristics of the West Virginia surface coal mining industry and of the significant environmental problems that may eventuate, the surface minable area of the State has been subdivided into five subregions (Figure 7). Except for the boundary between Subregions IV and V, the subregion boundaries are natural boundaries and occur in areas where surface mining is not expected to occur to any great extent prior to 1980. For convenience, the boundary between Subregions IV and V is the divide between the Elk River and the Gauley River drainage basins.

Surface Mine Subregion I

Surface mine Subregion I includes all of the northern coalfield in West Virginia. Two sections are recognized. In Hancock and Brooke Counties coal currently is being mined by surface techniques; in Ohio and Marshall Counties coal may be mined if the moratorium on surface coal mining ceases. The other section includes Preston, Barbour, northern Upshur, Lewis, northern Braxton, northeastern Gilmer, Harrison, Taylor, Marion, and Monongalia Counties (Figure 7).

Future production of surface coal from the northern panhandle counties (Hancock, Brooke, and potentially Ohio and Marshall Counties) is expected to be small, because the section already has been stripped extensively, is highly urbanized in places, and contains strippable reserves that generally are high-sulfur coals. Total production, new mine openings, and NPDES permit applications are expected to remain at low levels through 1980.

Table 7. Expected changes in West Virginia surface coal production by counties, 1975-1980. Tonnage data are thousands of short tons, from WV Department of Mines for 1975 and projections by seams for 1980 from Urbdata, Inc. + indicates an indeterminate percentage increase.

County	1975 Rank	1980 Rank	1975 Tonnage	1980 Tonnage	Change 1975-1980	% Change 1975-1980
Barbour	1	2	2,474	2,200	-274	-11
Boone	3	3	1,868	2,120	252	13
Braxton	25	24	67	150	83	124
Brooke	23	25	86	80	-6	-7
Clay	--	23	0	160	160	+
Fayette	14	15	564	615	51	9
Gilmer	24	26	86	70	-16	-19
Grant	19	19	343	410	67	29
Greenbrier	16	8	540	1,095	555	103
Hancock	--	29	0	5	5	+
Harrison	6	10	1,138	1,020	-118	-10
Kanawha	2	1	2,387	2,580	193	8
Lewis	13	12	664	700	36	5
Logan	9	6	928	1,310	382	41
McDowell	11	13	758	665	-93	-12
Marion	26	28	30	40	10	33
Mercer	27	27	28	50	22	79
Mineral	20	21	318	235	-83	-26
Mingo	15	17	555	540	-15	-3
Monongalia	8	9	968	1,065	97	10
Nicholas	5	5	1,272	1,475	203	16
Preston	4	4	1,733	1,770	37	2
Raleigh	10	11	826	780	-46	-6
Randolph	12	14	691	660	-31	-4
Taylor	22	22	173	170	-3	-2
Tucker	18	20	357	400	43	12
Upshur	7	7	1,042	1,230	-188	-18
Webster	21	16	266	550	284	107
Wyoming	17	18	470	450	20	-4
Total			20,632	22,595	1,963	10

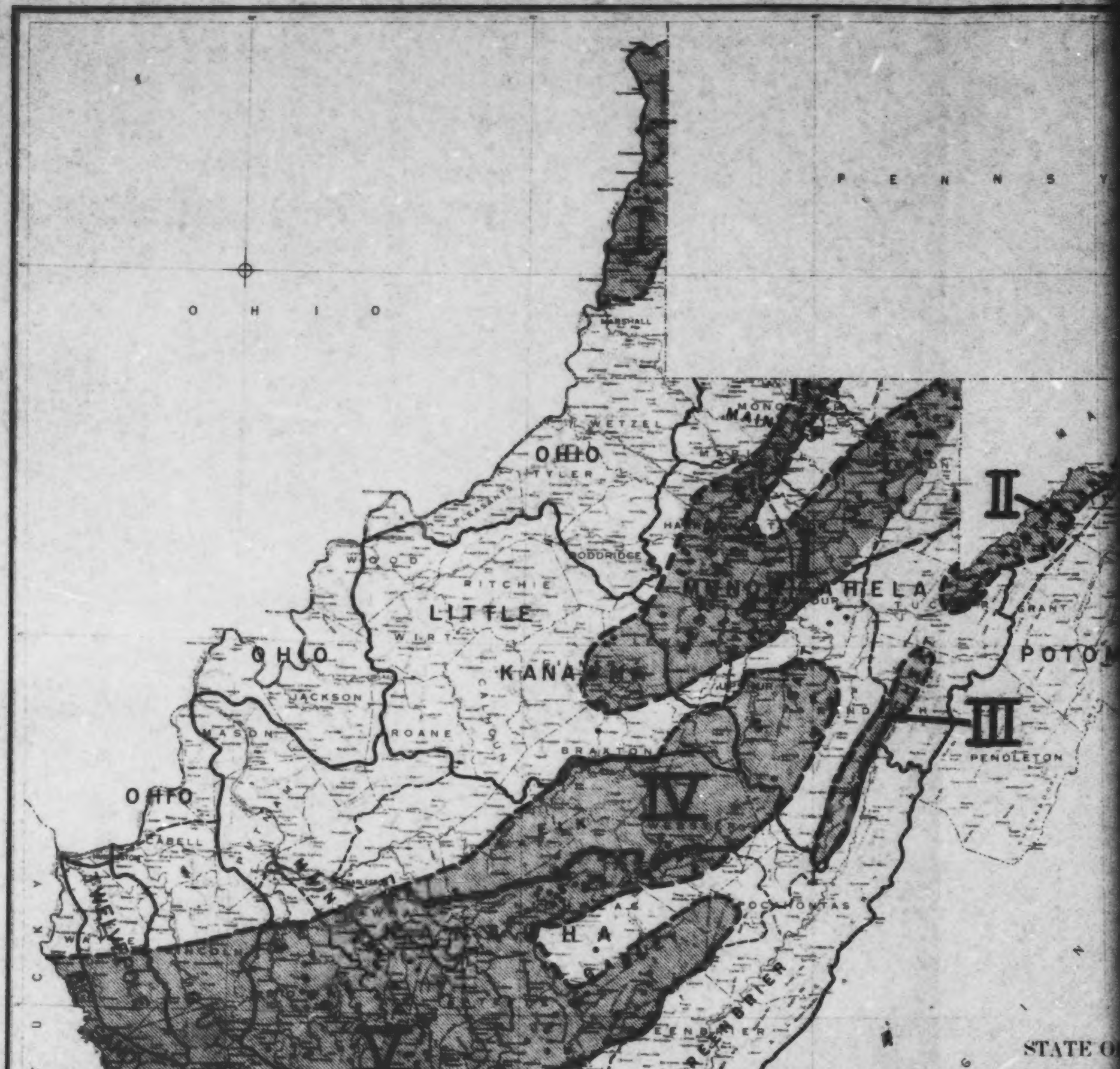
The larger eastern section of Subregion I also has had extensive surface and underground coal mining. The younger coal seams (Pittsburgh, Redstone, Waynesburg, and Sewickley) have supported most of the previous surface mining. In Monongalia, Marion, Harrison, Lewis, and Gilmer Counties they are the only seams that are expected to produce significant quantities of surface mined coal through 1980 (Table 8). In Preston County, production from the Pittsburgh coal seam has declined because past surface mining has almost exhausted Pittsburgh reserves. Production in Preston County is expected to remain high, however, as surface mining in the Elk Lick, Bakerstown, and Upper Freeport coal seams increases.

Production from surface mines in Subregion I has been mostly from mines that produce less than 100,000 tons per year (Table 3). Of the 184 mines that produced an average of 42,800 tons of coal during 1975, only 22 (12%) produced more than 100,000 tons per year. Almost half of the large mines (10) were situated in Barbour County. The 162 mines that produced less than 100,000 tons each during 1975 together produced about 52% of the total coal produced by surface mines in Subregion I. These small mines can be expected to complete all operations in less than two years.

Subregion II

Subregion II comprises the coal mining areas of Grant, Mineral, and Tucker Counties (Figure 7). Coal has been mined extensively by surface and underground methods in the past, primarily from the Bakerstown, Elk Lick, and Pittsburgh seams (Table 9). Subregion II is situated in the Southern Coalfield of West Virginia. Except for the Pittsburgh coal seam, which occurs at high elevations in the Subregion, the coals are mostly low-sulfur steam coals. Some of the production is dedicated to several large utility plants that are located nearby.

Although the increased production is not expected to be great through 1980 (Tables 6 and 7), surface mining will become more important as the coal reserves of existing underground mines become exhausted. Unmined coal seams in Subregion III are too irregular and discontinuous to support construction of large new underground mines (Verbally, 17 January 1977, Thomas Arkle, West Virginia Geological Survey). Permitted acreage for individual mines is expected to remain at current levels, and production from the Elk Lick, Bakerstown, and Pittsburgh seams is expected to account for the moderate increase in production.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KANAWHA
OHIO
WIRT
JACKSON
MASON
ROANE
BRAXTON
TUCKER
GRANT
POTOM
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PENDLETON
IV
OHIO
CABELL
ELK
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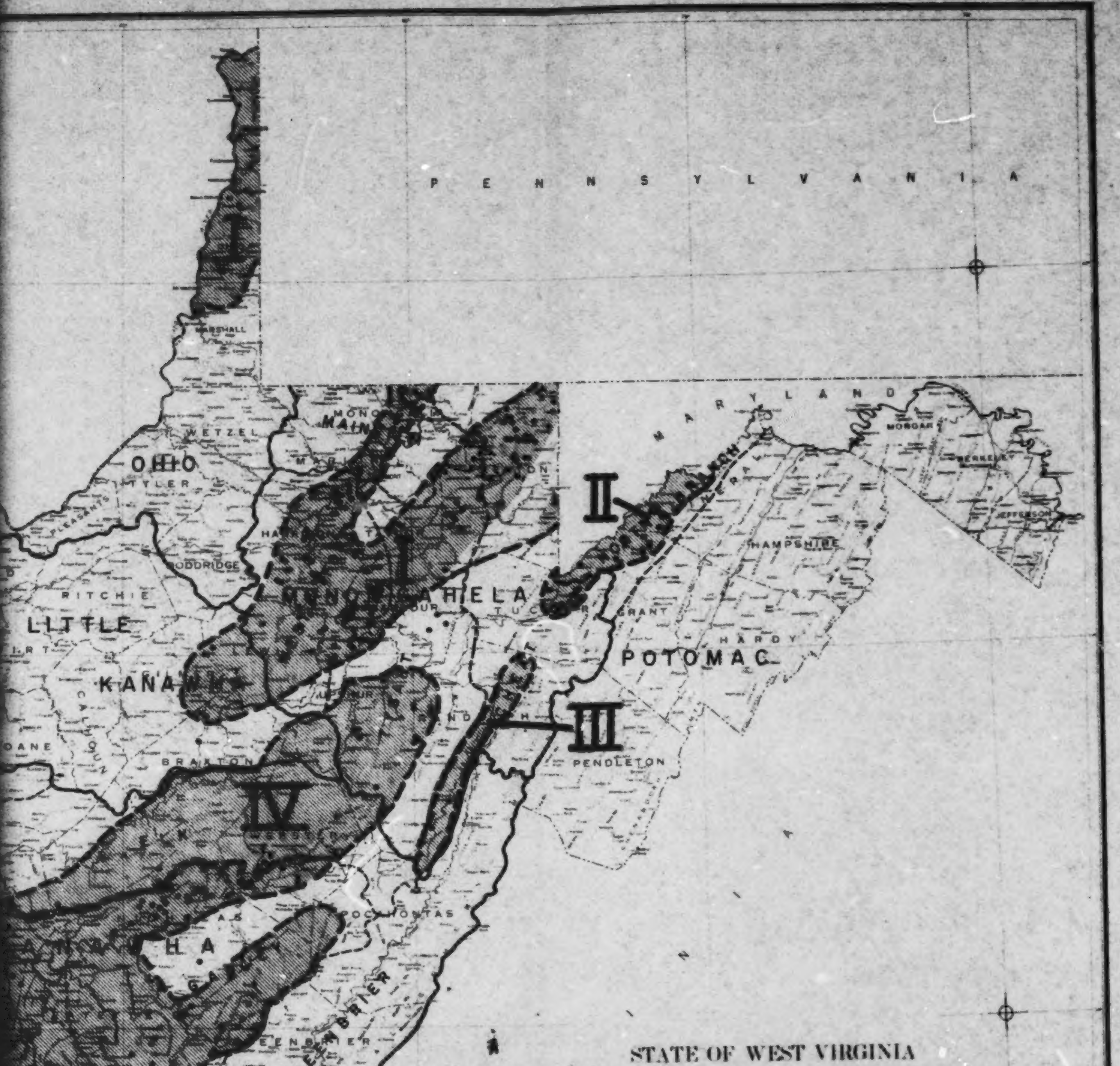
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RITCHIE
BRAXTON
TUCKER
GRANT
HARDY
HAMPSHIRE
MORGAN
BERKELEY
JEFFERSON
PENDLETON
POCAHONTAS
SUMMERS
MONROE

STATE OF WEST VIRGINIA

SURFACE COAL MINING SUBREGIONS

• ACTIVE SURFACE MINE, 1976.

FIGURE 7

B

Table 8. 1975 production of surface-mined coal, by county and by seam, in Subregion I, West Virginia (based on US Bureau of Mines data). A denotes number of mines, B denotes Short tons x 1000.

COAL SEAMS

Counties	Waynesburg		Sewickley		Redstone		Pittsburgh		Elk Lick		Bakerstown		Freeport[1]		Kittanning [2]		Total	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
Barbour					16	1597	6	589			6	73			1	177	29	2,456
Braxton							6	67									6	67
Gilmer							1	86									1	86
Harrison					6	481	29	643									35	1,124
Lewis					15	403	3	150	1	41					1	70	20	664
Marion					1	14	2	15									3	29
Monongalia	9	817	1	41	1	64									2	37	13	959
Preston							4	71	1	21	10	366	29	1101	3	173	47	1,732
Taylor							10	171									10	171
Northern Upshur[3]					7	227	8	143	5	239							20	609
Totals	9	817	1	41	46	2,786	70	1,935	7	301	16	439	29	1101	7	457	184	7,877

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[1] Includes Lower and Upper Freeport coal seams.

[2] Includes Lower, Middle, and Upper Kittanning coal seams.

[3] Includes production only in Subregion I.

Table 9. 1975 production of surface-mined coal, by county and by seam, in Subregion II, West Virginia (based on US Bureau of Mines data).

	COAL SEAMS															
	Pittsburgh		Elk Lick		Harlem		Bakerstown		Mahoning		Upper Freeport		Kittanning[1]		Total	
COUNTIES	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
Grant			6	269			4	75							10	344
Mineral	6	151	3	126	1	6	1	3	1	4			2	27	14	317
Tucker			1	7			4	187			5	164			10	358
Total	6	151	10	402	1	6	9	265	1	4	5	164	2	27	34	1,013

---

[1] Includes Lower, Middle, and Upper Kittanning coal seams.

Subregion III

Subregion III consists of the Shavers Fork drainage basin in Randolph and Pocahontas Counties. No production of surface mined coal occurred during 1975, but two surface mines were issued State mining permits in 1976. (These two mines are not on Federally owned land, although they are within the "Proclamation Line" of the Monongahela National Forest.) As of February 1976, US-EPA Region III had approved on existing source NPDES permit for an auger mine in the Shavers Fork Basin; a second auger mining permit was about to be issued. These surface mining permits were pending (By telephone, T. Fielding, US-EPA Region III, 23 February 1977). As of March 1977, WV-DNR reported 4 permitted surface mines and 3 pending surface mine applications (By telephone, Mr. W. Raney, Division of Reclaimation, WV-DNR, 8 March 1977).

Coal beds in Subregion III are discontinuous and podshaped (Verbally, Mr. Thomas Arkle, West Virginia Geological Survey, 17 January 1977), so that extensive prospecting will be required to assure successful mining operations. The coal beds of the New River Formation, however, contain high quality coals, including the metallurgical grade Sewell coal. Because the coal beds are high-quality but discontinuous, the area will be attractive for surface mining, but the surface mines are likely to be relatively small.

Subregion IV

Subregion IV comprises part of Clay, southern Braxton, southern Upshur, and northern Webster Counties, together with Nicholas County north of the Gauley River Basin. This Subregion includes the central part of the State, where production to present has been relatively low and almost exclusively restricted to the Kittanning seams (Table 10). Subregion IV may experience substantial increases in surface mining activity, because large corporations including oil, steel, and coal companies hold extensive leases in this region (Verbally, Mr. Thomas Arkle, West Virginia Geological Survey, 17 January 1977; Mr. John Sturm, West Virginia Surface Mining Association; Mr. Roger Hall, West Virginia Division of Reclamation, 17 November 1976). Future coal production is expected to be from the Kittanning coal seams.

Subregion V

Subregion V includes the southern counties of West Virginia where production of surface coal historically has been great, where abundant surface-minable reserves remain, where multiple-seam mining of thin and discontinuous metallurgical grade coals is common, and where large-scale, mountaintop removal methods, as well as contour surface mining along steep slopes, are typical. The mines range from the southeastern outcrops of older coals to younger coals in Boone and Kanawha Counties. Thirty two coal seams were mined by surface methods in Subregion V during 1975 (data from US Bureau of Mines).

Coal production exceeded 100,000 tons during 1975 at 27 surface mines in Subregion V. These mines represented 14% of the number of mines but produced 41% of the coal. The largest surface mine in the State (the Cannelton mine in Kanawha County)produced almost 650,000 tons from the Lower Kittanning coal seam. Twenty one of the mines produced coal either from the Kittanning coal seams or from the Stockton-Lewiston seams. The remainder of the large mines worked the Fire Creek, Welch, Alma, Lower Cedar Grove, Sewell and Eagle coal seams. To simplify the discussion of coal production, Subregion V is subdivided into three watersheds (the Kanawha River, the Guyandotte River, and the Big Sandy-Tug Fork drainage basins; Figure 7). Production data (1975) are summarized in Tables 11, 12, and 13 for each of these basins. The Kanawha River Basin of Subregion V encompasses the largest area and includes the greatest number of mines with the largest 1975 production among the subregions defined in this report. Nineteen of 142 mines (13%) produced more than 100,000 tons during 1975. In total, the large produced almost 3,000,000 tons (41%) of the production in this basin. One hundred twenty three mines (87%) produced 61% of the surface mined coal in this basin, which is about the same percentage of small mines as were previously described in Subregion I.

Twenty six surface mines produce coal in the Guyandotte River and in the Big Sandy-Tug Fork drainage basins. Production was similar in these two basins. The Big Sandy-Tug Fork drainage basin, however, is only partially situated in West Virginia; there is extensive coal mining in the Kentucky section of the basin also.

The northern section of Subregion V is the Kanawha River Basin exclusive of the Elk River (part of Subregion IV). All surface minable areas in Kanawha, Boone, Fayette, Raleigh, Mercer, Greenbrier, and southern Nicholas Counties are included in this section. The coals range from the Pocahontas to the Kanawha Formation (Table 11). Total production in this area is expected to increase about 17% from 7.3 million to 8.5 million tons through 1980. Much of this increase will occur from the low-sulfur, steam coal seams in the western part of the basin, particularly the Kittannings, Stockton-Lewiston, and Cedar Grove. The demand for metallurgical coal will support small operations that economically can mine small quantities of the highest-priced coals, as well as cause an increase in production of Sewell, Beckley, and Fire Creek coal seams, particularly those that are exposed in Greenbrier County.

Production in Kanawha and Boone Counties is projected to increase continued mining of the thick Coalburg, Stockton-Lewiston, and Kittanning coal seams is expected to account for much of the production. Because the still unmined outcrops of these coal seams occur primarily at higher elevations, it is probable that much of the production may come from a few mines that utilize top-of-mountain techniques.

Table 10. 1973 production of surface-mined coal, by county and by seam, in Subregion IV, West Virginia (based on US Bureau of Mines data). A denotes number of mines; B denotes thousands of short tons.

	Kittanning[1]		Stockton-Lewiston		Peerless		Eagle		Sewell		Total	
	A	B	A	B	A	B	A	B	A	B	A	B
Southern Braxton[2]	4	80									4	80
Clay	0	0									0	0
Northern Nicholas[3]	4	172									4	172
Randolph	4	445	1	31	4	33	1	19	4	161	14	689
Southern Upshur[4]	4	434									4	434
Northern Webster[3]	4	172			4	34					8	206
Total	20	1,303	1	31	8	67	1	19	4	161	38	1,581

---

[1] Includes Lower, Middle, and Upper Kittanning coal seams.

[2] Includes all production except from Pittsburgh coal seams, which are included in Subregion I.

[3] Includes mines located in the Elk River drainage basin only.

[4] Includes all production except from Elk Lick, Pittsburgh, and Redstone coals, which are included in Subregion I.

Table 11 1975 production of surface-mined coal, by county and by seam, in the Kanawha River Basin, Subregion V, West Virginia (based on US Bureau of Mines data). A denotes number of mines; B denotes thousands of short tons.

	COUNTIES															
COAL	Kanawha		Boone		Fayette		Southern Nicholas[1]		Raleigh		Mercer		Greenbrier		Total	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
Pittsburgh																
L. Freeport							1	114							1	114
Kittanning[2]	19	1,737	16	1,426	1	70	14	813							50	4,046
Stockton-Lewiston	9	457	4	271											13	728
Coalburg	1	67	1	81	1	70									3	218
Winifrede	2	59													2	59
N. Cedar Grove							1	2							1	2
Cedar Grove			1	99	1	17									2	106
Peerless							2	9							2	9
No. 2 Gas	1	64			1	11			2	75					4	150
Powellton					3	45			3	24					6	69
Eagle			1	1	5	144	5	79	2	203					13	427
Glenalum Tunnel					1	27									1	27
Gilbert					1	9									1	9
Bradshaw					1	61									1	61
Sewell					3	32	1	82	9	251			10	251	23	616
Beckley									3	140			1	67	4	207
Ninevah											1	18			1	18
Fire Creek													2	185	2	185
Pocahontas 6					2	69					1	9	3	26	5	104
Pocahontas 5									3	61					3	61
Pocahontas 4									1	57					1	57
Pocahontas 3											1	2	1	10	3	12
Total	35	2,384	23	1,868	20	555	24	1,099	23	811	3	29	17	539	142	7,285

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[1] Excludes production in the Elk River Basin.

[2] Includes production from Lower, Middle, and Upper Kittanning coal seams.

Production in Fayette, Greenbrier and Mercer Counties is projected to increase by 51, 555, and 22 thousand tons through 1980, respectively. Production probably will decrease in Raleigh County by 46 thousand tons, but small changes in marketability could affect the number of mines and tonnage production very substantially. Much of the production in these counties is for high-quality steam coals and metallurgical coal. Past surface mining in Fayette County has reduced the number of large tracts of unmined land, so that small mines in high-priced coal seams are expected. The large increase of surface mining production in Greenbrier County, which has not been minedby surface methods in the past, is expected from mines that will open in the Sewell and Fire Creek coal seams. The thin, as-yet unmined coal seams in Mercer County are found in steep-slope areas, but among them are the highest priced coals in the State. Except for some areas in Greenbrier County, the price of coal together with topography and geology, will favor small mines.

The Guyandotte River Basin in the central section of Subregion V encompasses Logan and Wyoming Counties, as well as Lincoln County (which currently is a moratorium county). Surface production from these counties has decreased in recent years, because great production from surface mines has depleted the readily accessible coal seams (Table 12). Four of the 15 mines produced 71% of the surface coal in Logan County during 1975 from the Lower Kittanning and Stockton-Lewiston coal seams. It is expected that production of coal from the Lower Kittanning and Stockton-Lewiston seams that are exposed at high elevations will account for much of the net 41% increase through 1980.

The southern section of Subregion V is the West Virginia half of the Big Sandy-Tug Fork Basin. This area encompasses Mingo and McDowell Counties, as well as Wayne County (in which no production occurred during 1975; Figure 7). During 1975 coal was produced from 16 coal seams that range from the New River Formation to the Allegheny Formation (Table 13).

Production from 5 of 26 surface mines that produced more than 100,000 tons during 1975 accounted for 48% of the total production of 1.3 million tons. Large tracts of in-place reserves are expected to be depleted in the near future, so future mining for high-quality coal will be from small surface mines.

As recently as 1971, production of surface coal in Mingo County was about 1.5 million tons, much of which was from the Cedar Grove, Alma, Winifrede, and Coalburg seams. Production declined drastically to 554 thousand tons in 1975 and is expected tocontinue to decrease slightly through 1980, because the easily accessible reserves have been depleted. The remaining seams are irregular and are overlain by massive sandstones which will increase the cost of surface mining.

Production in McDowell County is mostly from underground mines, because the geology and topography make it difficult to open large surface mines in the high quality metallurgical coals of the County.

Three of the 15 mines in McDowell County produced more than 100,000 tons from the Welch and Fire Creek coals during 1975. Production from surface mines is expected to decrease by 91 thousand tons through 1980 as reserves (particularly in the Welch and Fire Creek coal seams) are depleted.

Reclamation of Surface Mines in West Virginia

Promulgation of the West Virginia Surface Mining and Reclamation Act of 1967 (Code of West Virginia Chapter 20) established the Division of Reclamation within the Department of Natural Resources. The Division enforces the provisions of the West Virginia law and has issued regulations and procedures to insure enforcement. The Division primarily is responsible for monitoring the operation and reclamation of surface mines with active State permits. Secondarily, the Division oversees and directs the reclamation of orphaned surface mines -- mines that were not reclaimed or were improperly reclaimed prior to promulgation of the law.

Since 1961 about 206,000 acres of surface mines have been reclaimed (Table 14). Of this area about 21% (26,029 acres) have been reclaimed with monies from the Special Reclamation Fund administered by the Division of Reclamation (Table 14). The fund is financed by a $60.00 per acre tax on the land that is permitted for the production of surface coal. The use of monies of the fund, however, is restricted to the reclamation of orphaned mines and mines for which performance bonds are uncollectable. It does not cover reclamation of mines which experience pollution problems after bonds have been released in the established manner following inspection. (There is no providion for such areas).

The primary legal responsibility for proper mining and reclamation resides with the operator of a surface coal mine. As part of an application for a surface mine permit or a prospecting permit, the operator must include a reclamation plan which includes regrading specifications, growing-surface preparation plans, fertilization and planting program, and most important, an estimated schedule (Appendix A). The Division of Reclamation issues no mining permit until the reclamation plan has been approved, and a bond of $1,000.00 per acre of disturbed land has been posted.

The operator has the responsibility to reclaim land in accordance with his approved plan, either directly or through contract with other organizations such as local Soil Conservation Districts. In the event that a permit to prospect is followed by a permit to mine, the bond and approved reclamation plan (if appropriate) are transferred to the mining permit. In large operations reclamation typically begins as soon as mining ceases in one part of the mine, so that mining operations and reclamation are concurrent activities. During the latter part of 1976, the Division of Reclamation employed 32 surface-mine inspectors whose responsibility included an inspection of each operating surface mine in the State every 15 days. Mine inspectors can issue warnings regarding procedures that require rectification, can issue formal notices of violations, and must follow up violation notices with reinspection reports (Appendix A). In the event that violations are not rectified promptly, all mining operations can be suspended by order of the Division of Reclamation.

Table 12. 1975 production of surface-mined coal, by county and by seam, in the Guyandotte River drainage basin area of Subregion V, West Virginia (based on US Bureau of Mines data). A denotes number of mines; B denotes thousands of short tons.

	COUNTIES					
COAL SEAM	Logan		Wyoming		Total	
	A	B	A	B	A	B
L. Kittanning	5	344	1	60	6	404
Stockton-Lewiston	4	480	1	17	5	497
Winifrede	4	54			4	54
L. Cedar Grove	1	46			1	46
Ninevah	1	4			1	4
No. 2 Gas			1	40	1	40
Eagle			1	31	1	31
Bens Creek			1	11	1	11
Douglas			1	69	1	69
Sewell			2	91	2	91
Beckley			2	117	2	117
Pocahontas 3			1	35	1	35
Total	15	928	11	471	26	1,399

Table 13. 1975 production of surface-mined coal, by county and by seam in the Big Sandy-Tug Fork Basin, Subregion V, West Virginia (based on US Bureau of Mines data). A denotes number of mines; B denotes thousands of short tons.

	COUNTIES					
COAL SEAM	McDowell		Mingo		Total	
	A	B	A	B	A	B
L. Freeport			1	3	1	3
L. Kittanning			1	91	1	91
Coalburg			1	9	1	9
Winifrede			3	88	3	88
Cedar Grove			1	23	1	23
L. Cedar Grove			1	102	1	102
Alma			2	174	2	174
No. 2 Gas			1	64	1	64
Bens Creek	1	11			1	11
Douglas	2	36			2	36
Welch	5	340			5	340
Hundred	1	4			1	4
Fire Creek	2	258			2	258
Pocahontas 10	1	10			1	10
Pocahontas 4	1	6			1	6
Pocahontas 3	2	91			2	91
Total	15	756	11	554	26	1,310

Table 14. Acreage of surface coal mined land reclaimed in West Virginia, 1961 - 1976 (data from WV-DNR).

	Operator		WV-DNR		
YEAR	Soil Conservation District	Operator	Special Reclamation	Bond Forfeiture	Total
1961	878	-	-	-	878
1962	2,471	600	-	-	3,071
1963	2,574	460	-	-	3,034
1964	2,374	605	25	-	3,004
1965	3,668	901	787	-	5,356
1966	3,213	690	2,754	-	6,657
1967	4,100	740	2,553	-	7,393
1968	8,956	9,055	1,141	59	19,211
1969	8,253	4,463	3,874	527	17,117
1970	5,356	5,986	1,016	888	13,246
1971	5,253	12,321	2,660	36	20,370
1972	3,665	20,053	3,422	183	27,323
1973	1,240	19,982	4,045	65	25,332
1974	1,116	17,387	1,942	172	20,617
1975	664	13,895	928	53	15,540
1976	1,130	15,920	882	12	17,944
Total	55,011	123,058	26,029	1,995	206,093

Mine operators are specifically liable to lawsuits for damages within one year of the release of final reclamation bonds, and must carry at least $10,000 worth of insurance to cover this liability (West Virginia Code 20-6-30).

When the mine ceases production, reclamation must begin in accordance with the approved reclamation plan. After final grading is complete, WV-DNR can release 75% of the reclamation bond. The operator also must reestablish vegetation, and his bond cannot be released fully until two growing seasons have passed following regrading inspection. Any leachate breakthrough from underground sources or uncontrolled runoff is the responsibility of the operator and must be controlled at his cost, until the Division of Reclamation releases him, following a final inspection report from a mine inspector. If an operator fails to follow approved procedures or fails to control leachate or erosion, his posted bond is subject to forfeiture, whereupon the Division of Reclamation assumes responsibility for appropriate reclamation.

The Division of Reclamation conscientiously is enforcing the West Virginia surface mining laws and regulations, which are intended to reduce adverse impacts to the surface waters of West Virginia. A mine drainage application (Appendix A) must accompany the mining permit application. The 15-day mine inspections assure that improper practices are reported quickly. The reduction in the number of acres reclaimed by bond forfeiture (Table 14) concomitant with an increase in prosecutions (Table 4) is evidence of increasing enforcement during the 1970's. Recent interagency mine tour inspection reports also testify to an overall improvement in reclamation procedures, but there still is room for improvement (WV-DNR 1975a, 1976g). Finally, the total acreage reclaimed annually approximates the total acreage permitted during the previous year (Table 5), so there is at least a rough balance between current surface mining and reclamation. Prior to the 1970's, there was relatively little enforcement of regulations that require reclamation in West Virginia (Stanford Reserach Institute 1972). As of early 1977, the 1967 Act had not been amended to rectify faulty requirements relating the maximum permissible width of benches to the degree of slope (Stanford Research Institute 1972: 55-56, 141 ff.), but operating regulations within WV-DNR apparently had been adopted which addressed the proper relation of benches to slopes (Verbally, Mr. John Hall, WV-DNR, 4 March 1977).

II. AREAS SENSITIVE TO ENVIRONMENTAL DISRUPTION BY SURFACE COAL MINING IN WEST VIRGINIA

Introduction

This report section contains an inventory of available information on significant sensitive natural areas that potentially may be affected adversely by surface coal mining in West Virginia. Special effort has been made to insure completeness of data, within the limits of information available through February 1977, in the 29 counties where surface mining currently is permitted by the West Virginia Legislature. The general conclusion which can be drawn from these data is that sensitive resources of various types have in the past been affected adversely by surface mining throughout the surface coal mining regions of West Virginia. Progress in reducing adverse effects has been made during the 1970's, and the regulations imposed by the State have been instrumental in securing that progress. But at the present time Federal responsibility for environmental review remains more comprehensive than that imposed by State or local statute in West Virginia.

Archaeological Resources

Archaeological remains of one or more groups of prehistoric inhabitants may be found in virtually every type of environmental setting in West Virginia. Sites have been discovered in river valleys, on river terraces, on hills and mountaintops, in rock shelters on mountainsides, and on cliffs. Many archaeological sites remain to be discovered, because few parts of the State have been subjected to professional reconnaissance. Consequently, there are many gaps in the record of prehistoric West Virginia. The distribution of 1, 751 known archaeological sites indicated in Figure 8, should not be interpreted as an accurate depiction of the actual county distribution of archaeological sites.

In addition to prehistoric archaeological sites, many historic archaeological sites occur in West Virginia, only a few of which have been recorded and analyzed. A growing awareness of the importance of these sites probably will increase the number of recognized important historic archaeological sites in the future. Known historic sites include Harpers Ferry and Camp Allegheny in Pocahontas County. Potential sites exist in the Eastern Panhandle area, where historic Susquehannock tribes were known to have occupied sites on the South Branch River and on Blennerhassett Island in the Ohio River, where the remains of Blennerhassett Mansion are buried. Sites of many Civil War battles, frontier forts, and early iron furnaces are located in various sections of the State.

Records of known archaeological sites are maintained by the West Virginia Archaeological Survey. The State Archaeological Survey has no capability to undertake a comprehensive Statewide inventory, but it has performed reconaissance of specific sites on a contract basis. There is no requirement for identification or review of potential mining impacts on archaeological resources that may be situated on private lands as a result of State or local statutes in West Virginia (Verbally, Dr. Daniel Fowler, Archaeological Director, West Virginia Geological Survey, 10 October 1976). The identification of archaeological resources in West Virginia, therefore, together with any

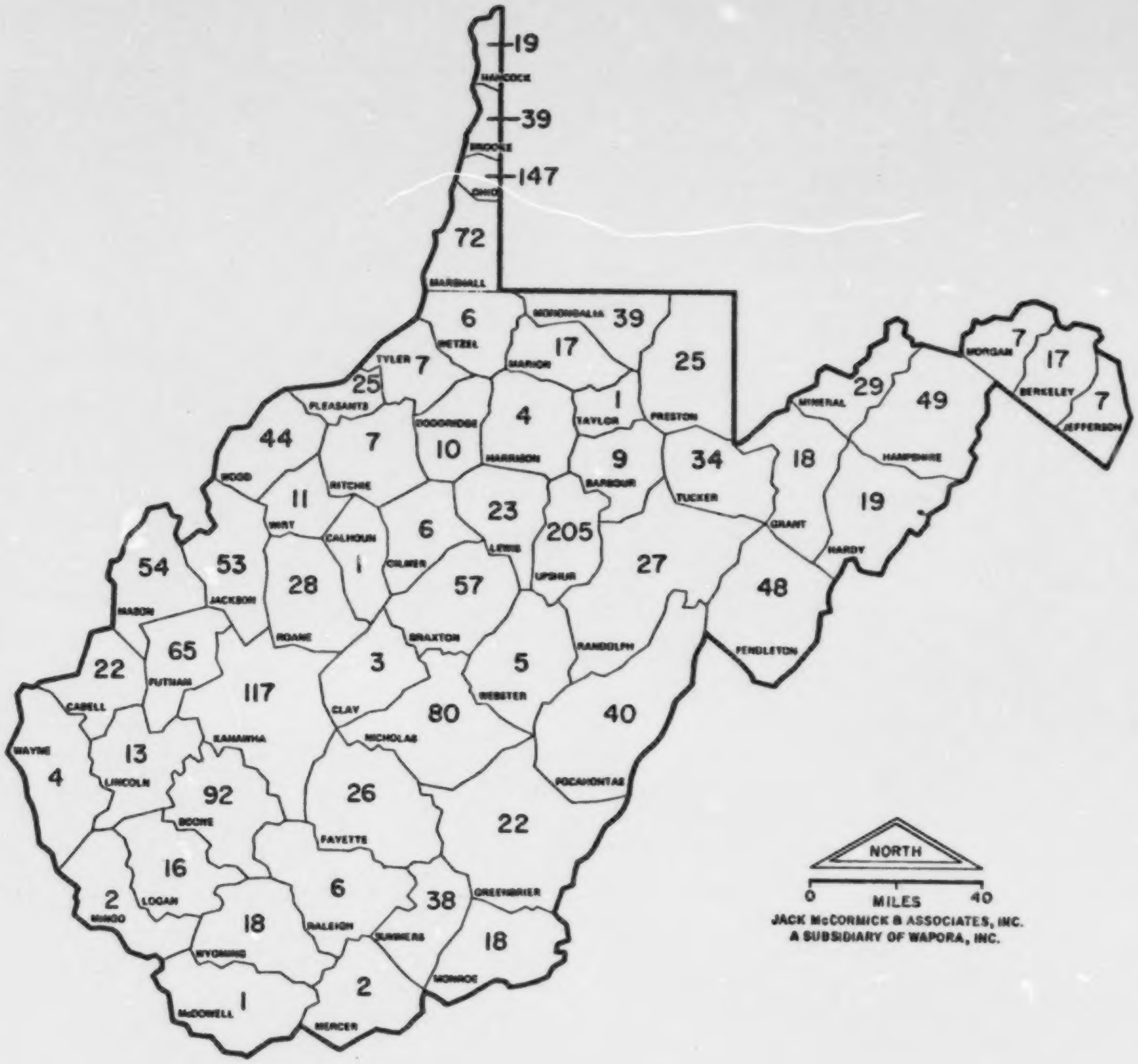
19
HANCOCK
39
BROOKE
147
OHIO
72
MARSHALL
6
WETZEL
MONONGALIA
39
17
MARION
25
PRESTON
TYLER
7
25
PLEASANTS
1
TAYLOR
44
WOOD
7
RITCHIE
10
DODDRIDGE
4
HARRISON
9
BARBOUR
34
TUCKER
MINERAL
29
18
GRANT
49
HAMPSHIRE
19
HARDY
7
MORGAN
17
BERKELEY
7
JEFFERSON
11
WIRT
1
CALHOUN
6
GILMER
23
LEWIS
205
UPSHUR
27
RANDOLPH
48
PENDLETON
54
MASON
53
JACKSON
28
ROANE
57
BRAXTON
65
PUTNAM
22
CABELL
117
KANAWHA
3
CLAY
5
WEBSTER
80
NICHOLAS
40
POCAHONTAS
WAYNE
4
13
LINCOLN
92
BOONE
26
FAYETTE
22
GREENBRIER
16
LOGAN
2
MINGO
6
RALEIGH
38
SUMMERS
18
WYOMING
18
MONROE
1
McDOWELL
2
MERCER
NORTH
0
MILES
40
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Figure 8. Number of known archaeological sites in West Virginia counties as of January 1976 (data from West Virginia Archaeological Survey).

minimization of or mitigation for adverse effects on these resources, is required only by the Federal laws which apply to the issuance of NPDES permits or other Federal actions.

Archaeological resources are highly susceptible to damage by surface mining, which entails a drastic modification of surface deposits. Because the distribution of such resources is so poorly known, because professional expertise is necessary to locate these resources and estimate their significance, and because these resources are irreplacable, US-EPA may seek to take special cognizance of these resources.

The following discussion summarizes the distribution of known archaeological sites, and it presents information on the distinct technological assemblages and remains of prehistoric cultural groups in West Virginia (Table 15). The earliest known inhabitants of West Virginia were groups known to archaeologists as Paleo-Indians, who inhabited the State by 12000 B.C. No camp sites or kill sites attributable to the early inhabitants have been discovered, but fluted projectile points (Figure 9) have been found on terraces of the Ohio River and the Kanawha River and on Blennerhassett Island in the Ohio River. Fluted points have been found elsewhere associated with mammoth and mastodon remains, and it is postulated that the Paleo-Indians lived in migratory bands and subsisted by hunting large game. At the time of the Valders maximum of the Wisconsin glaciation of the Pleistocene Epoch, the continental ice sheet advanced to within 400 miles of the Central Ohio Valley. In open areas not covered by ice and meltwater, game such as caribou and mastodon grazed. The large herbivores followed natural game trails along the water courses through the hills of West Virginia to reach the level grazing areas. It is believed that the Paleo-hunters also utilized the game trails and ambushed the large mammals at strategic passes and stream fords. Salt springs also attracted game.

Fluted points and Paleo-Indian occupation sites have been found on high sandy alluvial hillocks elevated about 100 feet above water-laid silt and loam of major river valleys such as the Ohio and Kanawha, as well as on upland flats a few miles from the Ohio River. Saline springs on these terraces attracted the large herbivores, and consequently early men also were drawn to these areas.

The typical artifact assemblage found at known Paleo-Indian sites included fluted projectile points, lanceolate projectile points, uniface blade-like snub-nosed scrapers, uniface side blades, gravers, and other blade and flake tools. Evidence from known occupation sites in the Ohio River Valley indicates that individual sites were occupied temporarily or seasonally over a long period of time.

By about 6000 B.C. the gradually changing climatic conditions had resulted in ecological changes which brought about the demise of large herbivores. Evidence from archaeological sites occupied after about 600 B.C. indicates that a concurrent change occurred in human food-gathering practices and settlement patterns. The several distinct modes of human adaptation to changing conditions at this time are manifested in various cultural assemblages at separate locations in West Virginia. It is likely

ARCHEOLOGICAL PERIODS AND CULTURES IN WEST VIRGINIA

Time and Period	Culture and Area			Period Description
	South	North	E. Panhandle	
Removal A.D. 1800 Historic A.D. 1750	Cherokee/Shawnee/Delaware/Seneca		Algonquian/Tuscarora/Susquehannock	Disruption of native culture; no aboriginal artifacts; few settlements in W. Va.
	Hiatus		Early Historic	"Hunting Ground" Period.
Late Prehistoric A.D. 1675 A.D. 1000	W. Shawnee? Fort Ancient	E. Shawnee? Monongahela	Monongahela Late Woodland	Settled stockaded village farmers; corn, beans and squash; warfare; burial within village; many material remains.
Middle Woodland Late A.D. 500	Buck Garden	Watson Farm	Montane Hopewell	Rise of village life and intensive horticulture; decline of mound building; Utilitarian material remains; stone mounds.
Early 100 B.C.	Armstrong	Wilhelm	?	"Classic Hopewell" period; burial mounds and cult still important. Scattered hamlets; hunting and gathering economic base.
Early Woodland 1000 B.C.	Adena	Adena	?	"Cult of Dead." Burial mounds very important; scattered hamlets; hunting and gathering economy supplemented by minor horticulture (sunflower).
Archaic Late 4000 B.C.	Buffalo?	Panhandle	Montane Archaic	Semi-sedentary specialized food gathering/hunting; beginning of polished stone tools.
Early 7000 B.C.	Kirk/St. Albans/Le Croy/Kanawha			Generalized hunting and gathering; little but chipped stone tools.
Paleo-Indian 13000 B.C.+	Cumberland Fluted Clovis Fluted			Nomadic big game hunters of now extinct mammals. Fluted projectile points.

Table 15. Nomenclature of West Virginia archaeological periods (McMichael 1968:2).

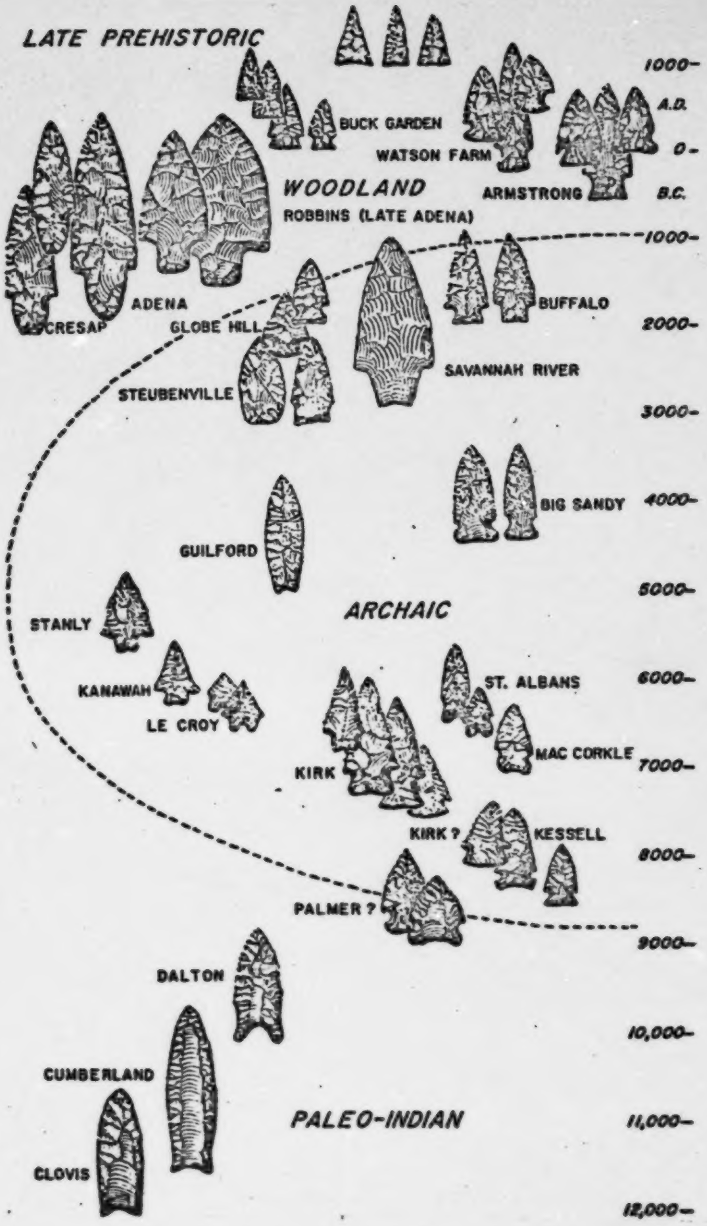
LATE PREHISTORIC
1000-
A.D.
BUCK GARDEN
WATSON FARM
0-
ARMSTRONG
B.C.
WOODLAND
ROBBINS (LATE ADENA)
1000-
BUFFALO
ADENA
CRESAP
GLOBE HILL
2000-
SAVANNAH RIVER
STEUBENVILLE
3000-
BIG SANDY
4000-
GUILFORD
5000-
ARCHAIC
STANLY
ST. ALBANS
6000-
KANAWAH
LE CROY
MAC CORKLE
KIRK
7000-
KIRK ?
KESSELL
8000-
PALMER ?
9000-
DALTON
10,000-
CUMBERLAND
PALEO-INDIAN
11,000-
CLOVIS
12,000-

Figure 9. Chronological sequence of identified projectile point types from West Virginia (McMichael 1968:7).

that Paleo-Indians supplemented their diets with whatever small game, vegetables, grains, and fruits they could gather; as the large game became scarce, however, human populations became more and more dependent upon the full variety of food resources that could be collected in a given area.

Some of these groups, known as Archaic cultures, subsisted primarily on shellfish. Evidence of their occupation sites has been found in the northern Panhandle of West Virginia on the lower terraces of the Ohio River. Large mounds of clam shells, fish bones, and other refuse were found on the east bank of the Ohio River. Typical artifacts recovered from the shell middens included broad stemmed and lanceolate spearpoints, grooved adzes, atlatl weights, bone awls, and harpoon points. It is believed that because of their more constant food supply, the Archaic peoples were able to live in larger, more settled groups than the Paleo-hunters. They perhaps changed their campsites seasonally.

Remains of Archaic cultural groups have been found at the St. Albans site within the City of St. Albans, Kanawha County. This site was occupied intermittently between 7500 B.C. and 6000 B.C. Seasonal flooding of the river sealed each occupation. The site has been excavated to 18 feet below surface. Six different types of projectile points were uncovered, each in a separate zone. In addition to projectile points, chipped flint hoes, flint scrapers, drills, and fragments of faceted hematite were recovered.

Remains of an Archaic tradition known as the Montane Archaic occur in the eastern extremity of the State. Spearheads and other tools ordinarily manufactured from flint elsewhere in the State were shaped by the Montane groups from quartz, quartzite, hematite, and sandstone. An Archaic component also was found at the Buffalo site in Putnam County.

The later Archaic sites contain evidence of increasing dependence on grain and vegetables as food sources. Pigweed and goosefoot may have been cultivated. Bowls of the mineral steatite were made prior to the introduction of vessels made of clay. Grave offerings and red ocher often accompanied burials. The Archaic culture evolved into the Woodland manifestation. Pottery making and mound building were associated with most of the Woodland sites.

Several types of mounds built by distinct cultural groups occur throughout West Virginia. The earliest, the Adena burial mounds, occur in the Ohio River and Kanawha River valleys and were built between 1000 B.C. and 1 A.D. The Adena has more elaborate life-styles and technology than the Archaic groups. There was an increased dependence on cultivation of crops such as pumpkins, gourds, and sunflowers, which permitted larger groups to be supported in semi-permanent villages. Ceremonialism expanded to include burial in mounds. During the first 500 years of Adena culture burial mounds were modest and included utilitarian objects such as stemmed projectile points, plain tubular pipes, cord-marked pottery tempered with grit, and whetstones. Settlements consisted of groups of circular houses of pole and bark construction.

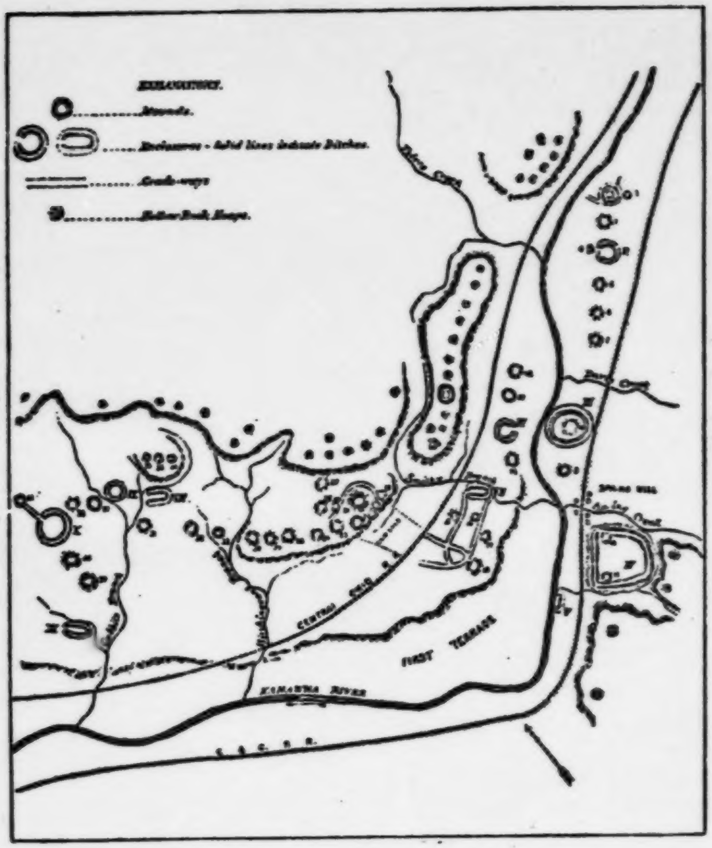
Mounds.
Grade-ways
FIRST TERRACE
KANAWHA RIVER

Figure 10. Mound and earthwork group west of Charleston (Dunbar-South Charleston), 1887. Except for the South Charleston, Shawnee Reservation, and a few smaller mounds, this group of prehistoric remains has been destroyed totally (McMichael 1968:18).

Late Adena sites contained evidence of cultural influences from groups to the north and west, known as Hopewell cultural groups. Circular earthworks, such as those formerly in the Charleston area (Figure 10) were good examples of late Adena mounds. Such mounds also occurred around the bases of Grave Creek Mound (Figure 11). Mounds covered log tombs in which one or more burials had been placed, and many tombs were destroyed during the later construction of a mound. Grave goods included ornamental offerings such as effigy pipes, pendants, gorgets, copper bracelets and rings, and grooved stone tablets. Late Adena houses were of double-post side wall construction. Adena mounds include Grave Creek Mound at Moundsville (and 50 associated mounds, most of which have been destroyed), Cresap Mound, Natrium Mound, Welcome Mound, and the large group of mounds in and around Charleston, of which one remains in the center of Charleston. The distribution of Adena sites is indicated in Figure 11.

Influences from the Hopewell culture, which reached its zenith in Ohio during Middle Woodland times, were reflected in late Adena cultural remains. In the Kanawha Valley, cultural remains from the period between 1 A.D. and 500 A.D. contain a mixture of Adena and Hopewell elements. Small earthen mounds contained cremations. Scattered villages were composed of circular houses, simple agriculture was practiced, and the tools included small flake knives and corner and side-notched projectile points made of flint that came from Flint Ridge, Ohio. In central West Virginia the Buck Garden Culture succeeded the earlier mixed Adena-Hopewell culture, known as the Armstrong culture (Figures 11 and 12). Burials of the Buck Garden cultural group were found in rock shelters and overhangs in central West Virginia. The Buck Garden people also built stone mounds and introduced the cultivation of corn, beans, and squash. This new food resource base permitted the Buck Garden people to live in compact villages. By 1200 A.D. these people had been driven from the Kanawha Valley, but they persisted in the hills to the north and south of the Kanawha River for some time.

While the Armstrong people inhabited the Kanawha River Valley and central West Virginia, another Middle Woodland group, known as the Wilhelm Stone Cist Mound Builders lived in the Ohio River Valley section of northern West Virginia. These people constructed earth mounds over a number of individual stone-lined graves. Platform pipes, Flint Ridge flint knives, and notched points were among the remains of the Wilhelm groups. Succeeding the Wilhelm Stone Cist Mound Builders in the northern panhandle of West Virginia were the Watson Farm Stone Mound Builders, who built stone mounds with multiple burials. Individual graves or grave chambers (cists) were absent from the Watson Farm remains. The mounds contained both flexed and extended corpses, cremations, and secondary burials. These people lived in compact villages and utilized pottery that was tempered for strength using crushed limestone. Subsistence was based on corn-bean-squash agriculture.

During the Early and Middle Woodland periods, the mountainous sections of the eastern part of West Virginia were inhabited by cultural groups whose remains contain evidence of Hopewellian influences, and who built numerous small mounds. Such mounds occur in the Tygart Valley of Randolph County. The Romney Cemetery, the Hyre Mound, and the Don Bosco Mounds were built by the Montane Mound Builders. Distributions of these sites are indicated in Figure 13.

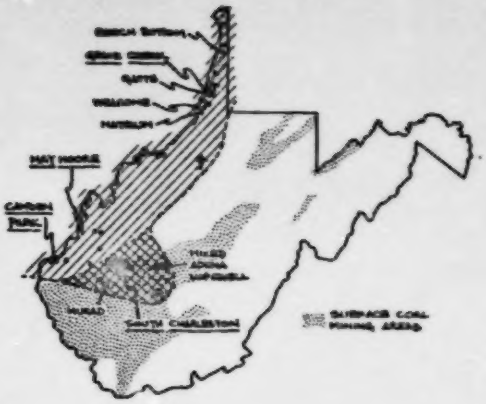
GRAVE CREEK
MIXED ADENA HOPEWELL
SOUTH CHARLESTON
CAMDEN PARK
SURFACE COAL MINING AREAS

Figure 11. Area of Adena Culture in West Virginia. The four underlined mounds are the largest in the State; the other named mounds have been excavated by modern scientific methods and are the source of most information about Adena in West Virginia (after McMichael 1968).

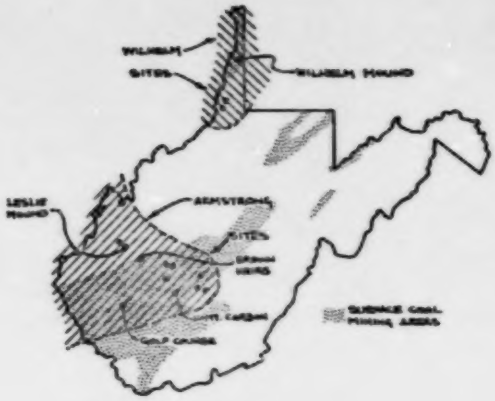
WILHELM
SITES
WILHELM MOUND
LESLIE MOUND
ARMSTRONG
SITES
SURFACE COAL MINING AREAS

Figure 12. Distribution of Early Middle Woodland sites in West Virginia, 1 to 500 A.D. (after McMichael 1968).

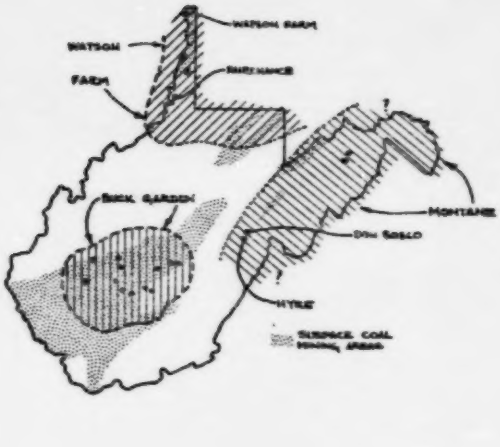
WATSON FARM
WATSON
FARM
BUCK GARDEN
?
MONTANE
HYRE
?
SURFACE COAL MINING AREAS

Figure 13. Distribution of Late Middle Woodland Sites in West Virginia, A.D. 500 to 1000 (after McMichael 1968).

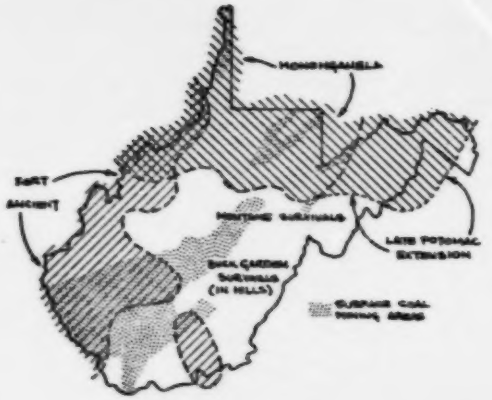
MONONGAHELA
FORT
ANCIENT
MONTANE SURVIVALS
LATE POTOMAC EXTENSION
BUCK GARDEN SURVIVALS (IN HILLS)
SURFACE COAL MINING AREAS

Figure 14. Distribution of Late Prehistoric Cultures in West Virginia. The area of overlap of the Fort Ancient and Monongahela Cultures contains Monongahela-like sites in the earlier part of the period, but Fort Ancient sites later (after McMichael 1968).

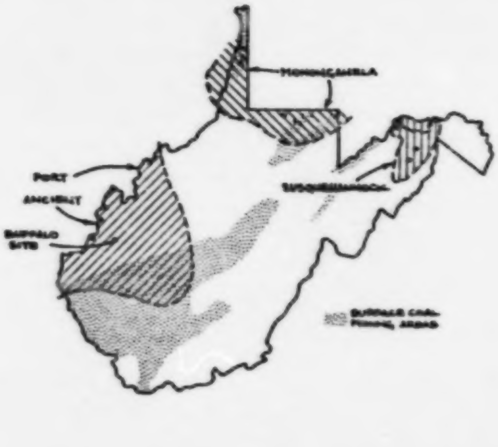
MONONGAHELA
FORT
ANCIENT
BUFFALO
SITE
SUSQUEHANNOCK
SURFACE COAL MINING AREAS

Figure 15. Known sites in West Virginia at the time of European contact (after McMichael 1968).

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In the Kanawha River and Ohio River valleys the final prehistoric period of occupation between 900 and 1700 A.D. is represented by remains of groups known as Fort Ancient people. Influences from the Mississippian culture near St. Louis affected these cultures in West Virginia. The Fort Ancient people lived in large, compact villages surrounded by stockades, with rows of rectangular houses. The villagers farmed corn, beans, and squash. There were open plazas in the centers of the villages, and as many as 1,500 persons lived within the stockades. Burials were no longer made in mounds. The dead were placed in pits inside the villages or inside house walls. Artifacts included small, triangular projectile points, drills, scrapers, blades, hoes, celts, awls, fish hooks, bird bone flutes, shell beads, ear plugs, and pottery vessels and pipes. Some late Fort Ancient sites contained European trade goods. Variations of the Fort Ancient culture occurred at Parkersburg and in the New River-Bluestone River area.

Stockaded villages of Fort Ancient groups were constructed in the northern and eastern sections of the State (Figure 14) between 1000 and 1700 A.D. At this time the Buck Garden people continued to manifest their separate cultural identity in remote sections of central West Virginia. In the eastern mountains Middle Woodland cultures, unaffected by Mississippian traits, persisted much later than 1000 A.D. The Monongahela Culture developed in the Monongahela River valleyof northern West Virginia. Villages of these cultural groups consisted of 1- or 2-acre stockaded settlements which contained circular huts of pole and bark construction. Burials were in pits. Settlements of the Monongahela cultural groups were considerably smaller than Fort Ancient villages.

European goods were found in some Fort Ancient and Monongahela sites. As there was only one recorded incident of European contact with a Fort Ancient village, it is believed that most European goods were obtained through trade. Locations of sites known to have existed at the time of European contact (ca. 1650 A.D.) are indicated in Figure 15. By 1700, Fort Ancient and Monongahela villages were abandoned. The fate of the former village occupants and their historic tribal connections are unknown. There is some indirect evidence that Fort Ancient villages were built by western Shawnee Indians, remnant populations of which were discovered by Europeans in the Cumberland River sections of Tennessee and Kentucky. It is also possible that eastern Shawnees occupied the Monongahela villages of late prehistoric times. (The Eastern Shawnees inhabited sections of the Carolinas at the time of earliest European contact.) During historic times Susquehannocks from western Pennsylvania entered West Virginia, and there is evidence of their presence in the Eastern Panhandle between 1630 and 1677. Their sites occur on the valley of the South Branch River in Hampshire County. Susquehannocks had no apparent connection, however, with the indigenous prehistoric groups of West Virginia. By 1700 A.D., except for the Eastern Panhandle area where a few aboriginal Algonkian-speaking tribes remained, West Virginia was devoid of its indigenous Indian populations, and the State was utilized only as a hunting ground. Later, Indian groups returned to or moved into West Virginia. Many of these were vassals or subgroups of the Iroquois. Shawnees and displaced Delawares were the primary groups to occupy sections of West Virginia during historic times.

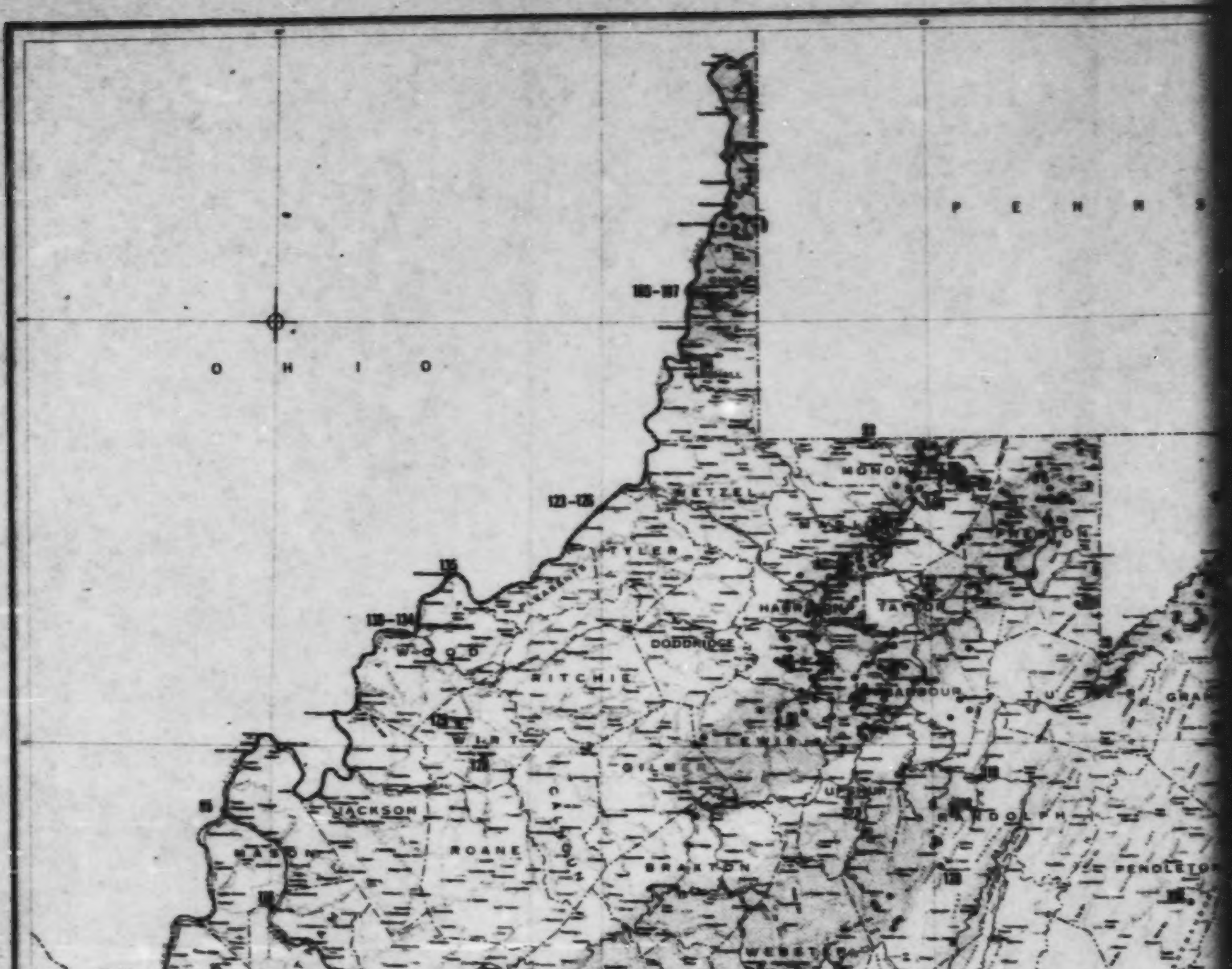
Historic Resources

At present about 140 historically and culturally significant standing structures, districts, and objects have been determined eligible for the National Register of Historic Places in West Virginia (Table 16; Figure 16). The majority of the listed sites are in settlements. Many more structures exist whose significance has not yet been discovered or determined.

There is an ongoing survey to identify historic resources in the State under the auspices of the West Virginia Antiquities Commission in accordance with the National Historic Preservation Act of 1966 (P.L. 89-665). Copies of the State Preservation Plan for historic preservation are not available at present. The Commission recommends a project-by-project environmental review of proposed surface mine sites (By letter, Leonard M. Davis, State Historic Preservation Officer, WV Antiquities Commission, Morgantown, 5 January 1977).

No state or local statutes apparently require the identification of historic sites or assessments of potential impacts of surface mining on historic sites in West Virginia. The WV-DNR is empowered to delete land from permit applications, the mining of which will constitute a hazzard to dwellings, public buildings, and various other sensitive receptors (West Virginia Code 20-6-11). This authority may protect known historic buildings and other sites already in public ownership. It presumably offers little protection to historic sites that are not widely known and are not on public land.

Public Law 94-429 requires that the Advisory Council on Historic Preservation be consulted whenever surface mining activities may result in adverse effects on properties designated as National Historic Landmarks. National Historic Landmarks in West Virginia include the Grave Creek Mound in Moundsville (Marshall County) and the Wade-Alexander House in Morgantown (Monongalia County; NPS 1972).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DODDRIDGE
WOOD
RITCHIE
BARBOUR
TUCKER
GRANT
WIRT
LEWIS
GILMER
CALHOUN
UPSHUR
JACKSON
RANDOLPH
MASON
ROANE
BRAXTON
PENDLETON
WEBSTER
CABELL
KANAWHA
CLAY
NICHOLAS
POCAHONTAS
WAYNE
LINCOLN
BOONE
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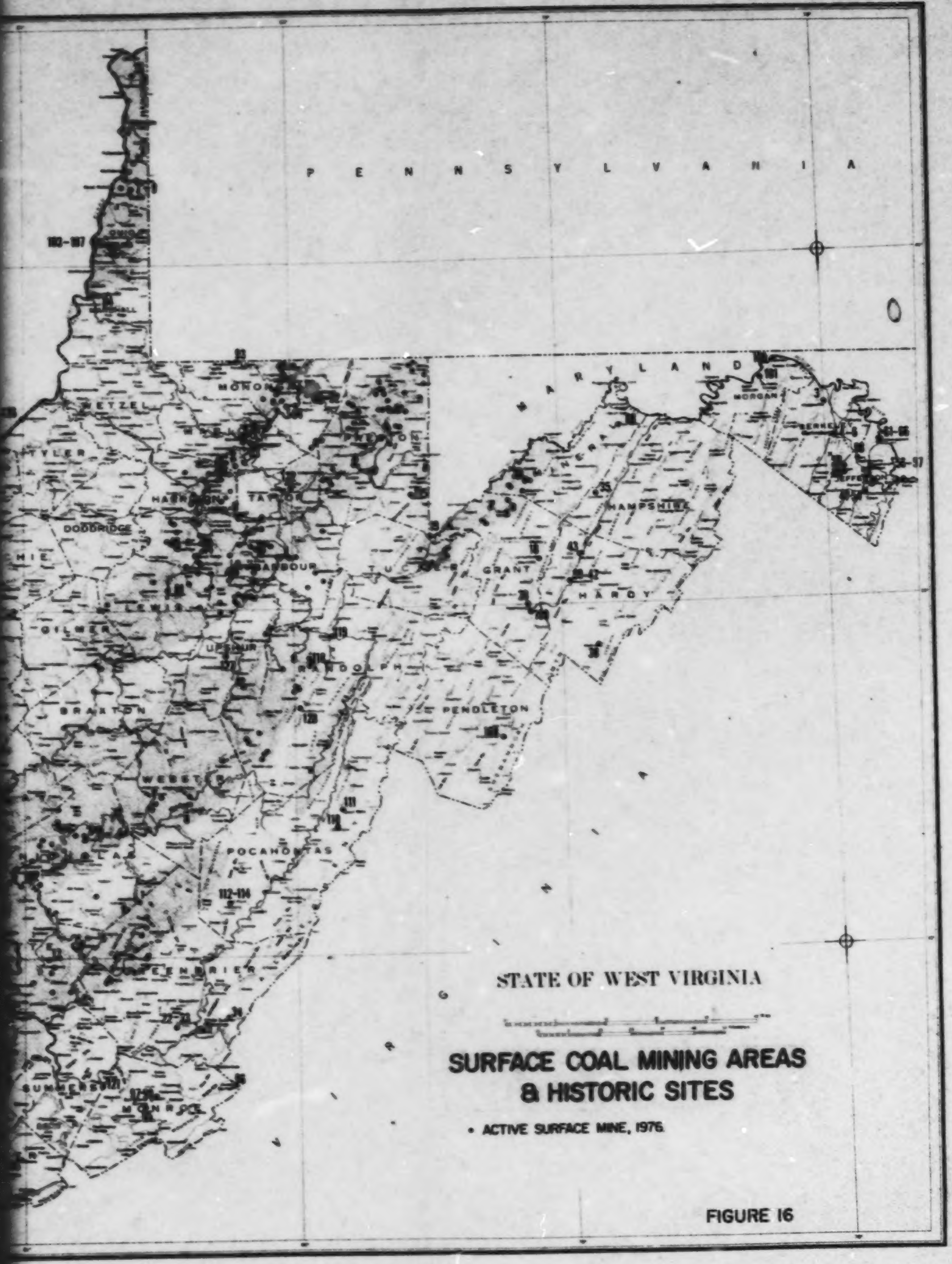
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TUCKER
MINERAL
HAMPSHIRE
MORGAN
BERKELEY
JEFFERSON
GRANT
HARDY
LEWIS
GILMER
UPSHUR
RANDOLPH
PENDLETON
BRAXTON
WEBSTER
POCAHONTAS
GREENBRIER
SUMMERS
MONROE
102-107
112-114
ACTIVE SURFACE MINE, 1976.

STATE OF WEST VIRGINIA

SURFACE COAL MINING AREAS & HISTORIC SITES

• ACTIVE SURFACE MINE, 1976.

FIGURE 16

B

Table 16. Properties listed on or eligible for the National Register of Historic Places in West Virginia (42 FR 6350-6351, 6362; 1 February 1977). Numbers refer to locations in Figure 16. Sites included in the Historic American Building Survey are designated HABS; National Historic Landmarks are indicated by NHL. Sites with an asterisk (*) are eligible for listing.

1. Philippi. Philippi Covered Bridge, Main Street, over Tygart River Barbour County.

1(a). Arden vicinity. Aqua Springs (Thomas Thornbrough House), SW of Arden on SR 37, Barbour County.

*2. Covered bridge across Rooting Creek, Elk Creek Watershed, Barbour County, (also in Harrison County).

3. Hedgesville vicinity. Snodgrass Tavern, W of Hedgesville on WV 3, Berkeley County.

3(a). Hedgesville vicinity. Cunningham, Samuel, House SE of Hedgesville off WV 9, Barbour County.

3(b). Hedgesville vicinity, Hedges, Samuel, House S of hedgesville on SR 37, Barbour County.

4. Martinsburg. Boydville, 501 S. Queen Street, Berkeley County.

5. Martinsburg. Federal Aviation Administration Records Center (Old Court House, 300 W. King Street), Berkeley County.

6. Martinsburg. Stephen, Adam, House, 309 E. John Street, Berkeley County.

6(a). Bethany. Old Bethany Church, Main and Church Streets, Berkeley County.

7. Bethany. Old Main, Bethany College, Bethany College campus, Brooke County.

8. Bethany. Pendleton Heights, Bethany College campus, Brooke County.

9. Bethany vicinity. Campbell, Alexander, Mansion, E of Bethany on WV 67, Brooke County.

10. Huntington. Baltimore and Ohio Railroad Depot, 1100 block of 2nd Avenue, Cabell County.

11. Huntington. Carroll, Thomas, House, 234 Guyan Street, Cabell County.

12. Huntington. Harvey House, 1305 3rd Avenue, Cabell County.

13. Huntington. Old Main, Marshall University, 16th Street, Marshall University campus, Cabell County.

*14. Huntington. Old Bank Building, 1206 3rd Avenue, Cabell County.

15. Milton. Mud River Covered Bridge, Off U. S. 50 on SR 25 over Mud River, Cabell County.

Table 16. National Register historic sites (continued).

16. Ansted. Contentment, Along U.S. 60, Fayette County.

17. Clifftop vicinity. Tyree Stone Tavern (Old Stone House, E of Clifftop off U.S. 19 on SR 10), Fayette County.

18. Lahmansville vicinity. Snyder,Noah, Farm, 1.5 mile S of Lahmansville on Route 5, Grant County.

18(a). Petersburg vicinity. The Manor, N of Petersburg off WV 42, Grant County.

19. William vicinity. Fairfax Stone site, N of William at corner of Grant, Preston, and Tucker Counties, Grant County.

20. Petersburg vicinity. The Manor, N of Petersburg off WV 42, Grant County.

21. Caldwell. Elmhurst, U.S. 60, Greenbrier County.

22. Lewisburg. Greenbrier County Courthouse and Lewis Spring, Corner of Court and Randolph Streets, Greenbrier County.

23. Lewisburg. John Wesley Methodist Church, E. Foster Street, Greenbrier County.

23(a). Lewisburg. Mt. Tabor Methodist Church, Court and Foster Streets, Greenbrier County.

24. Lewisburg. North, John A., House (Star Tavern, 100 Church Street), Greenbrier County.

25. Lewisburg. Old Stone Church (Presbyterian), Church and Foster Streets, Greenbrier County.

26. Lewisburg. Price, Gov. Samuel, House, 224 North Court Street, Greenbrier County.

27. Lewisburg. Supreme Court Library Building (Greenbrier County Library and Museum, U.S. 60W and Courtney Drive), Greenbrier County.

28. Lewisburg. Withrow, James, House, 200 N. Jefferson Street, Greenbrier County.

29. Lewisburg vicinity. Creigh, David S., House (Montescena, SW of Lewisburg off the Davis-Stuart Road), Greenbrier County.

30. Lewisburg vicinity. Hartland (Rogers Farm, 2 miles W of Lewisburg on Houfnagle Road), Greenbrier County.

31. Lewisburg vicinity. Stuart Manor, SW of Lewisburg off U.S. 210, Greenbrier County.

32. Lewisburg vicinity. Tuckwiller Tavern, 2 miles NW of Lewisburg on U.S. 60, Greenbrier County.

33. Lewisburg vicinity. Arbuckle, Alexander W. I., House (Baker, Michael, House), 2 miles N of Lewisburg on Arbuckle Lane, Greenbrier County.

Table 16. National Register historic sites (continued).

34. White Sulphur Springs. Greenbrier, The, Off U.S. 60, Greenbrier County.

35. Junction vicinity. Sloan-Parker House (Stone House, E of Junction on U.S. 50), Hampshire County.

36. New Manchester. Old Courthouse, High and Elm Streets, Hancock County.

37. Weirton vicinity. Tar, Peter, Furnace site, N of Weirton off WV 2, Hancock County.

38. Mathias vicinity. Lee, Lighthorse Harry, Cabin, W of Mathias in Lost River State Park, Hardy County.

39. Moorefield. Old Hardy County Courthouse, Winchester Avenue and Elm Street, Hardy County.

40. Moorefield vicinity. Fort Pleasant, N of Moorefield, Hardy County.

41. Moorefield vicinity. Mill Island, S of Moorefield, Hardy County.

42. Moorefield vicinity. Willows, The, S of Moorefield, Hardy County.

43. Old Fields vicinity. Willow Wall, S of Old Fields, Hardy County.

44. Lost Creek vicinity. Smith, Watters, Farm on Duck Creek, W of Lost Creek off U.S. 19 in Watters Smith Memorial State Park, Harrison County.

45. Shinnetor. Shinn, Levi, House, Clarksburg Rd. (U.S. 19), Harrison County.

45(a). Clarksburg. Groff, Nathan Jr., House, 463 W. Main Street, Harrison County.

46. Good Hope vicinity. Indian Cave Petroglyphs, County Route 2, Harrison County.

47. Charles Town. Cedar Lawn, 3.5 mile W of Charles Town off VA 51, HABS, Jefferson County.

48. Charles Town. Jefferson County Courthouse, N. George and E. Washington Streets, HABS, Jefferson County.

49. Charles Town. Richwood Hall, about 4 miles W of Charles Town off WV 51, Jefferson County.

50. Charles Town vicinity. Claymont Court, SW of Charles Town off U.S. 340, HABS, Jefferson County.

51. Charles Town vicinity. Harewood, W of Charles Town off WV 51, Jefferson County.

52. Charles Town vicinity. Washington, Charles, House (Happy Retreat), S of Charles Town off WV 9, HABS, Jefferson County.

Table 15. National Register historic sites (continued).

53. Charles Town vicinity. Worthington, Robert, House (Piedmont), 2 miles W of Charles Town off WV 51, HABS, Jefferson County.

55. Halltown vicinity. Beall-Air, W of Halltown off U.S. 340, Jefferson County.

56. Harpers Ferry. Harpers Ferry National Historical Park. At confluence of Shenandoah and Potomac Rivers, HABS, Jefferson County.

57. Harpers Ferry. St. Peter's Roman Catholic Church, Church Street and Jefferson Rock Trail, Jefferson County.

58. Kearneysville. Traveller's Rest, 3.3 miles NW of Leetown on WV 48, NHL, HABS, Jefferson County.

59. Leetown. Prato Rio, WV 48, HABS, Jefferson County.

60. Leetown vicinity. Woodbury. NE of Leetown, Jefferson County.

61. Shepherdstown. Rumsey Hall (Entler Hotel, German and Princess Sts.), Jefferson Co.

62. Shepherdstown. Shepherd's Mill, High Street, Jefferson County.

63. Shepherdstown. Shepherdstown Historic District, bounded roughly by Mill, Rocky, Duke, and Washington Streets (Jefferson County).

64. Shepherdstown vicinity. Cold Spring, S of Shepherdstown on CR 17, HABS, Jefferson County.

65. Shepherdstown vicinity. Elmwood, S of Shepherdstown on CR 17, HABS, Jefferson County.

66. Shenandoah Junction. Hazelfield, NW of Shenandoah Junction off Warm Springs Road, Jefferson County.

67. Cedar Grove. Cedar Grove (William Tompkins House, SE of Junction of U.S. 60 and Kanawha and James River Turnpike, Kanawha County.

68. Cedar Grove. Little Brick Church (Virginia's Chapel, 0.75 mile E of Kelley's Creek on U.S. 60), Kanawha County.

69. Charleston. Craik-Patton House (Elm Grove),U.S. 60 in Daniel Boone Roadside Park, Kanawha County.

70. Charleston. Craik-Patton House (Elm Grove), 1316 Lee Street, Kanawha County.

71. Charleston. Holly Grove Mansion, 1710 E. Kanawha Blvd., Kanawha County.

72. Charleston. Sunrise (MacCorkle Mansion, 746 Myrtle Road), Kanawha County.

73. Charleston. West Virginia Capitol Complex, Along Kanawha Blvd. E, Kanawha County.

*74. Charleston. Kanawha County Courthouse, Kanawha County.

Table 16. National Register historic sites (continued).

75. Charleston. Fort Scammon, Fort Circle Drive, Kanawha County.

76. Dunbar. Dutch Hollow Wine Cellars, Dutch Hollow Road, Kanawha County.

77. Malden. African Zion Baptist Church, 4104 Malden Drive, Kanawha County.

78. Marmet. Ebenezer Chapel, Ohio Avenue S at Hillview Drive, Kanawha County.

79. South Charleston. South Charleston Mound (Criel Mound), Kanawha County.

80. St. Albans. St. Albans site, between U.S. 60 and the Kanawha River, Kanawha County.

*80(a). St. Albans, Chilton House, 439 B Street, Kanawha County.

81. Jackson Mill vicinity. Jackson's Mill, E of Jackson Mill on Route 1, Lewis County.

82. Barrackville. Barrackville Covered Bridge, WV 21, over Buffalo Creek, Marion County.

83. Fairmont vicinity. Prickett's Fort, E of Fairmont, off WV 73, Marion County.

84. Moundsville vicinity. Grave Creek Mound, NHL,Marshall County.

85. Point Pleasant. Point Pleasant Battleground, SW corner of Main and 1st Streets, Mason County.

86. Athens vicinity. French, Colonel William Henderson, House, W of WV Route 20, Mercer County.

87. Princeton. Hale, Dr. James W., House, 1034 Mercer Street, Mercer County.

88. Fort Ashby. Fort Ashby, South Street, Mineral County.

89. Cheat Neck vicinity. Henry Clay Furnace, SE of Cheat Neck in Cooper's Rock State Forest, Monongalia County.

90. Morgantown. Old Stone House, Chestnut Street, Monongalia County.

91. Morgantown. Wade-Alexander House, 256 Prairie Street, NHL, Monongalia County.

92. Morgantown. Woodburn Circle, University Avenue, West Virginia University, Monongalia County.

93. Pentress vicinity. Mason and Dixon Survey Terminal Point (Brown's Hill), 2.25 miles NE of Pentress on WV 39, Monongalia County.

94. Ringgold vicinity. Hamilton Farm Petroglyphs, Monongalia County.

95. Salt Sulphur Springs vicinity. Indian Creek Covered Bridge, 1.5 mile S of Salt Sulphur Springs on U.S. 219, Monroe County.

Table 16. National Register historic sites (continued).

96. Sweet Springs. Old Sweet Springs, WV, Monroe County.

97. Union vicinity. Rehoboth Church, 2 miles E of Union off WV 3, Monroe County.

98. Union vicinity. Spring Valley Farm, NE of Union on U.S. 219, Monroe County.

99. Union vicinity. Elmwood (Hugh Caperton House), N of Union off US 219, Monroe County.

100. Chesapeake and Ohio Canal National Historical Park, Morgan County.

101. Berkeley Springs. Berkeley Springs State Park, S. Washington and Fairfax Streets, Morgan County.

102. Kesslers Cross Lanes vicinity. Carnifex Ferry State Park, S of Kesslers Cross Lanes off WV 129, Nicholas County.

103. Wheeling. Center Wheeling Market, Market Street between 22nd and 23rd Streets, HABS, Ohio County.

104. Wheeling. Independence Hall, 1524 Market Street, HABS, Ohio County.

105. Wheeling. Shepherd Hall (Monument Place), Monument Place and Kruger Street, HABS, Ohio County.

106. Wheeling. Wheeling Suspension Bridge, over Ohio River from 10th Street, Wheeling, to Virginia Street, Wheeling Island, NHL, HABS, Ohio County.

*107. Wheeling. B & O Railroad Freight Station and Train Shed, Ohio County. [demolished 1975].

108. Brandywine vicinity. Propst Lutheran Church, Pendleton County.

109. Petersburg vicinity. Old Judy Church, about 10 miles S of Petersburg on U.S. 200, Pendleton County.

110. Cass. Cass Scenic Railroad, along railroad tracks from Cass to Bald Knob, Pocahontas County.

111. Green Bank vicinity. Reber Radio Telescope, National Radio Astronomy Observatory, NE of Green Bank on WV 28, Pocahontas County.

112. Hillsboro vicinity. Buck, Pearl, House, NE of Hillsboro on U.S. 219, Pocahontas County.

113. Marlinton vicinity. Droop Mountain Battlefield, About 14 miles S of Marlinton on U.S. 219, Pocahontas County.

114. Marlinton. Hunter, Frank and Anna, House, U.S. 219, Pocahontas County.

115. Aurora vicinity. Red Horse Tavern (Old Stone House), 1 mile E of Aurora, Preston County.

116. Buffalo vicinity. Buffalo Indian Village Site, Putnam County.

Table 16. National Register historic sites (continued).

117. Beckley. Wildwood (General Alfred Beckley Home), 117 Laurel Terrace, Raleigh County.

118. Beverly. Blackman-Bosworth Store, Main and Court Streets, Randolph County.

119. Elkins. Graceland (Henry Gassaway Davis Home), Davis and Elkins College campus, Randolph County.

120. Huttonsville. Hutton, E. E., House, Junction of U.S. 219/250 and Union Street, Randolph County.

121. Lowell vicinity. Graham,Col. James, House (Graham's Fort), WV Route 3, Summers County.

122. Grafton. Andrews Methodist Church (Mother's Day Shrine), E. Main Street between St. John and Luzader Streets, Taylor County.

123. Sistersville. Durham, E. A.,House, 110 Chelsea Street, Tyler County.

124. Sistersville. Sistersville City Hall, City Square, Main and Diamond Streets, Tyler County.

125. Sistersville. Sistersville Historic District, from Chelsea to the Ohio River between Catherine and both sides of Virginia Streets, Tyler County.

126. Sisterville. Wells Inn (Wells Hotel, 316 Charles Street), Tyler County.

127. French Creek. French Creek Presbyterian Church, Route 2, Upshur County.

128. Burning Springs. Burning Springs Complex, along the N bank of the Kanawha River from the confluence of Burning Springs Run, Wirt County.

129. Elizabeth. Beauchamp-Newman House, Court Street, Wirt County.

130. Parkersburg vicinity. Blennerhassett Island Historic District, on the Ohio River, 1.7 mile S of Parkersburg, Wood County.

*131. Parkersburg. Wood County Courthouse, Wood County.

*132. Parkersburg. Wood County Jail, Wood County.

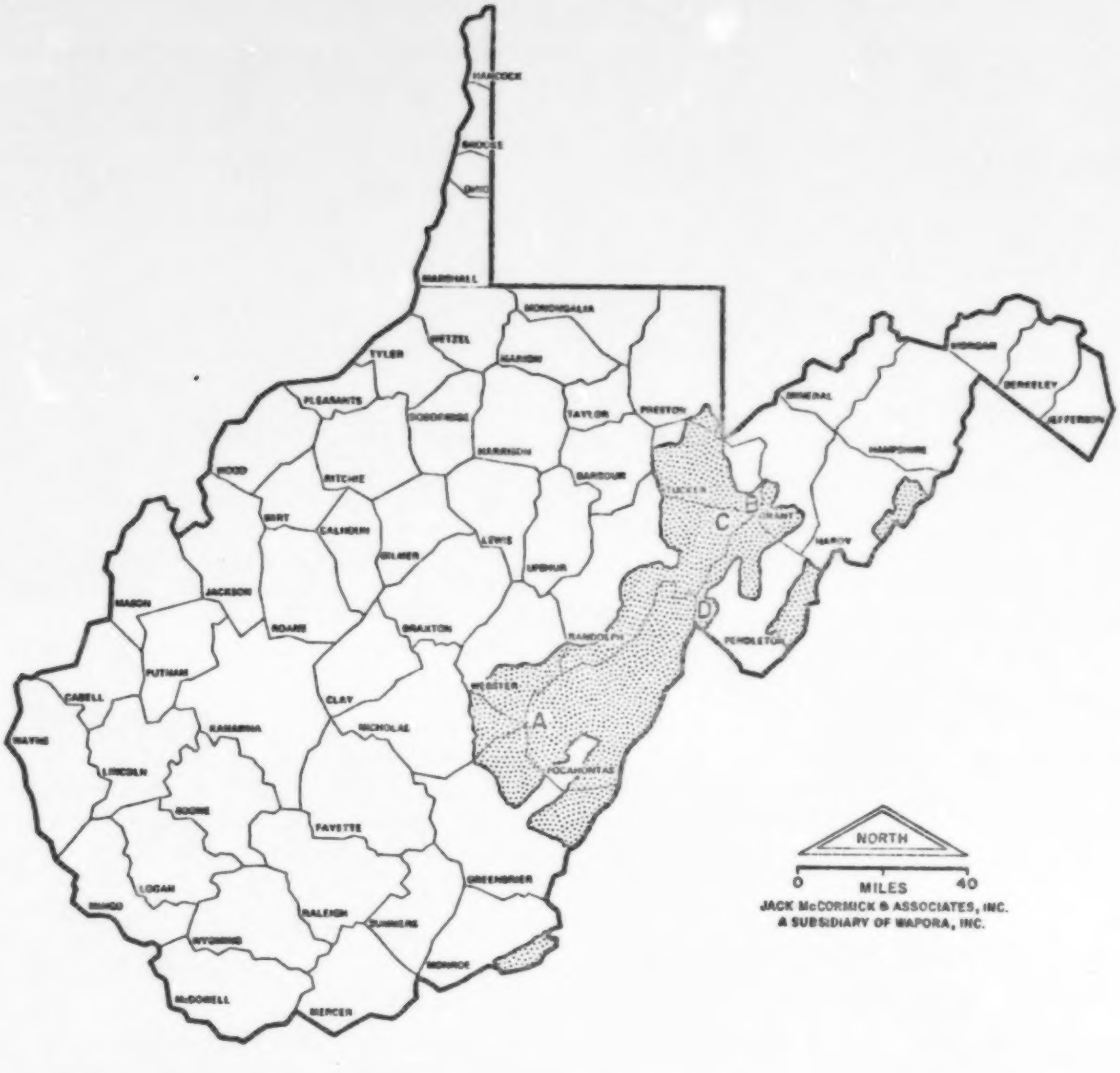
135. Williamstown. Tomlinson Mansion, 901 W. 3rd Street, Wood County.

Wilderness Areas

Wilderness Areas are particularly susceptible to adverse effects by surface mining of coal. Each mine site is disrupted completely during mining, and may regain a pre-mining appearance only slowly following reclamation. Even if off-site effects on water quality and other natural resources are held to insignificant levels, every mining operation requires transportation facilities to convey its products to market. The construction of rail and road facilities is virtually certain to reduce the isolation which is essential for wilderness experience, and the adverse aesthetic effects of both mining and transport activities on wilderness landscapes are likely to be significant during and long after mine operations.

Congress has classified the 20,000-acre Otter Creek area of Randolph and Tucker Counties and the 10,215-acre Dolly Sods area of Randolph, Grant, Tucker, and Pendleton Counties as wilderness areas within the Monongahela National Forest (P.L. 93-622, 3 January 1975; Figure 17, Table 18). The Cranberry Back Country(26,300 acres in Webster and Nicholas Counties) was placed in a wilderness study category, and recommendations are due to Congress by 1980. The Laurel Fork area also has been proposed as a wilderness area. It includes 11,656 acres, of which 1,154 are in West Virginia (Wilderness Committee 1973). The Outdoor Recreation Division of WV-DNR has underway a program to identify and recommend measures for the protection of other wilderness areas in the State (GOFSR 1975).

Mineral ownership in most sections of the Monongahela National Forest where there are minable coal resources is not by the Federal government, which owns 839,630 acres of land surface but only 497,895 acres (59%) in fee simple (USFS 1977). In the Dolly Sods Wilderness Area, 8,500 acres have mineral reservations which give the owner the right to mine coal and other minerals. Recent exploration for coal in the Otter Creek Wilderness Area has been conducted with equipment transported by helicopter and on horseback (Verbally, Dr. James Rawson, WV-DNR, Elkins, 15 December 1976). Two underground mines are being opened in the Cranberry Back Country, and two surface mines have been opened in the watershed of Shavers Fork. Only Laurel Fork is situated entirely within the current surface coal mining moratorium area, and lies outside the area with minable coal.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WOOD
RITCHIE
BARBOUR
TUCKER
WIRT
CALHOUN
GRANT
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BERKELEY
JEFFERSON
HAMPSHIRE
HARDY
LEWIS
GILMER
UPSHUR
JACKSON
MASON
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RANDOLPH
PENDLETON
PUTNAM
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WEBSTER
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Figure 17. Established and proposed wilderness areas in West Virginia National Forests (shaded). The areas are A, Cranberry Back County (under study); B, Dolly Sods; C, Otter Creek; D, Laurel Fork (proposed). The boundaries of National Forests depicted in this report are generalized approximations of authorized boundaries; actual patterns both of land ownership and of areas designated under wilderness categories are irregular in detail and cannot be shown on small-scale maps.

Parks and Recreational Facilities

Parks and recreational areas in West Virginia are operated by Federal, State, and local agencies, as well as by private interests. Recreation is a major industry that employs 42,000 West Virginians, and brings $680 million into the State annually (WV-DOC 1976).

Federally Administered Facilities

The Army Corps of Engineers, the National Park Service, the Fish and Wildlife Service, and the Forest Service administer recreational lands in West Virginia. Corps of Engineers lakes are inventoried in the section on surface water resources. Recreational facilities administered by the Corps of Engineers are listed in Table 17.

The National Park Service administers three installations which are situated partly in West Virginia. One of these is the Appalachian Trail, a National Scenic Trail about 2,000 miles long. A 9-mile long segment of the Appalachian Trail follows the West Virginia State Line southward along the boundary of Jefferson County from Harpers Ferry. In Harpers Ferry, the Service administers the Harpers Ferry National Historical Park, of which 564 acres (47% of the Federal acreage) is situated in West Virginia. The Harpers Ferry National Historical Park may be expanded by the National Park Service. A small segment (3 of 10,366 Federal acres) of the Chesapeake and Ohio Canal National Historical Park extends into Jefferson County (NPS 1975).

The National Park Service maintains the National Register of Historic Places, and the National Register of Historic Landmarks, which are discussed in the section on Historic Sites. It also maintains the Register of National Natural History Landmarks, which is discussed in the section on biological resources. These facilities are not Federally owned or Federally administered.

The Fish and Wildlife Service, like the National Park Service, is part of the Department of the Interior. In West Virginia it administers three fish hatcheries at Bowden (Randolph County), Leetown (Jefferson County), and White Sulphur Springs (Greenbrier County; GOFSR 1975).

The Forest Service is part of the Department of Agriculture. It administers almost 1 million acres in the sections of three National Forests which are situated in West Virginia. This land represents about 6% of West Virginia, but only about 0.5% of the National Forest land in the Nation. The George Washington National Forest occupies 100,386 acres in Hampshire, Hardy, and Pendleton Counties, and the Jefferson National Forest includes 18,245 acres of Monroe County. The largest Forest Service unit in West Virginia, however, is the Monongahela National Forest, which consists of 839,630 acres in eight counties (Figure 18, GOFSR 1975). Recreational use of the Monongahela National Forest was described in detail by the Forest Service (USFS 1977).

Table 17. Corps of Engineers recreational facilities in West Virginia (GOSFR 1975). Abbreviations: ACE, Army Corps of Engineers; WV-DNR, West Virginia Department of Natural Resources.

Project	Facility	Management Agency	County
Belleville Locks and Dam	Parkersburg	Parkersburg	Wood
	Williamstown	Williamstown	Wood
Bluestone Lake	Downstream No. 1	ACE	Summers
	Downstream No. 2	ACE	Summers
	Bull Falls	WV-DNR	Summers
	Bertha	WV-DNR	Summers
	Mouth of Ind. Cr.	WV-DNR	Summers
	Shanklines Ferry	WV-DNR	Summers
	Cedar Branch	WV-DNR	Summers
	Bluestone State Park	WV-DNR	Summers
	Rt. 20 Roadside Park	WV-DNR	Summers
	Town Park	WV-DNR	Summers
East Lynn Lake	Dam Site	ACE	Wayne
	Below Dam	ACE	Wayne
	Lake Side	ACE	Wayne
	Lake Creek	ACE	Wayne
	East Fork	ACE	Wayne
Gallipolis Locks and Dam	Gallipolis Lock	ACE	Mason
	Pt. Pleasant Site	City of Pt. Pleas.	Mason
	Mason City Site	Mason City, WV	Mason
Greenup Locks and Dam (Ohio River)	Guyandotte Site	WV-DNR	Corbell
London Locks and Dam	London Locks	ACE	Kanawha
Marnet Locks and Dam	Marnet Locks	ACE	Kanawha
Racine Locks and Dam	Racine Locks	ACE	Mason
	Ravenswood	ACE	Mason
Summersville Lake	Dam Site	ACE	Nicholas
	Tailwaters	ACE	Nicholas
	Battle Run	ACE	Nicholas
	Salmon Run	ACE	Nicholas
	Long Point	ACE	Nicholas
	Long Point	Maridorbes Corp.	Nicholas
	Rt. 19 Roadside Park	WV Highway Dept.	Nicholas

Table 17. Corps of Engineers recreational facilities in West Virginia (concluded).

Project	Facility	Management Agency	County
Sutton Lake	Downstream	ACE	Braxton
	South Abutment	ACE	Braxton
	Bee Run	ACE	Braxton
	Baker Run Mill Cr.	ACE	Braxton
	Kanawha River	ACE	Braxton
	Brock Run	ACE	Braxton
Winfield Lock and Dam (Kanawha River)	Winfield Locks	ACE	Kanawha
Monongahela Waterway (9 Locks and Dams)	Pool 8, Monongahela R.	ACE	Monongahela
	Morgantown L/D	ACE	Monongahela
	Hildebrand L/D	ACE	Monongahela
	Cockicha L/D	ACE	Marion
	Prickett Bay	WV-DNR	Marion
Ohio River Mile 0-127 (6 Locks and Dams)	Kennedy Park	Hancock County	Hancock
	Pike Island L/D	Hancock County	Hancock
	Buffalo Creek	Hancock County	Hancock
Tygart Lake	Dam Picnic Area	Hancock County	Taylor
	State Park	WV-DNR	Taylor
	Pleasant Creek	WV-DNR	Taylor

According to the Forest Service, only 58% of the Monongahela National Forest is owned in fee simple (USFS 1970). The rights to mine coal and other minerals are held by private interests beneath the remaining 42% of the National Forest. Such lands include most of the coal deposits within the Forest boundaries. None of the categories of land designated by Congress or by the Forest Service bars mining from lands beneath which there is no Federal ownership of mineral rights. Accordingly, two underground mines are being opened in the Cranberry Back Country Wilderness Area (in which only 25% of the mineral rights are Federally owned), and two surface mines are operating in the watershed of the Shavers Fork, a tributary of the Cheat River.

Most of the Federal surface landholdings in the Monongahela National Forest were acquired prior to World War II, before surface coal mining was practiced in West Virginia. Many deeds specified that transfer of surface rights did not impair the rights of the mineral owner to extract minerals by methods generally in use at the time of sale. The Forest Service, therefore, has adopted the position that surface mining can be prohibited from lands where the surface is Federally owned (By telephone, R. F. Mumme, Forest Supervisor, Monongahela National Forest, 1 March 1977). This position has been upheld in Federal court (US versus Sam G. Polmo et al. 1955, 131 Fed. Supp. 772), and there has been no surface mining on National Forest land in West Virginia since 1955. The Forest Service apparently has no control over surface mining on private lands surrounded by or adjacent to Federal lands. The extent of non-Federal mineral ownership beneath the Monongahela National Forest has been mapped by the Forest Service (USFS 1977:12).

The Forest Service has acquired mineral rights in the Dolly Sods Wilderness Area during recent years, but the high value ($190 million in 1973) of mineral resources beneath the Cranberry Back Country and in the Shavers Fork basin make extensive Federal acquisition there an unlikely possibility (USFS 1977:11). Specially classified areas in the Monongahela National Forest are listed in Table 18.

The State Outdoor Recreation Division has expressed interest in the recreational potential of the Allegheny Historic Area, the Headwaters of the Gandy River, and the Sinks of Gandy within the Monongahela National Forest (GOFSR 1975).

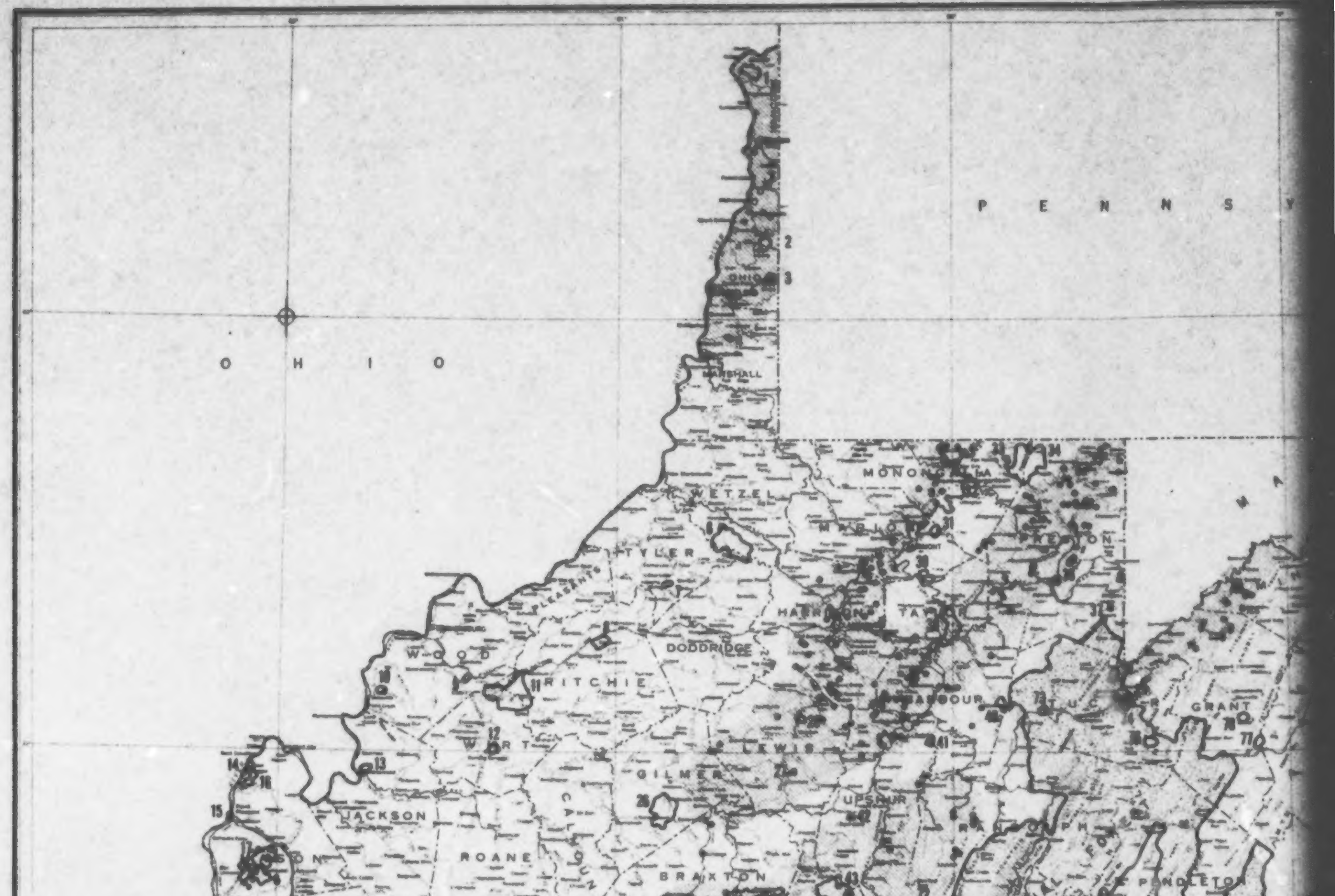
State Administered Facilities

According to the State Outdoor Recreation Division, the State of West Virginia held 276,265 acres of land and 1,707 acres of water for recreational use in 1975 (GOFSR 1975). This is less than 2% of the State. Fish and game lands made up 50%; State forests, 28%; and State park lands, 22% of the total. The major State facilities are mapped in Figure 18 and listed in Table 19. In addition, there were 197 State roadside parks adjacent to highways and more than 400 roadside tables during 1975 (GOFSR 1975).

Funds have been appropriated by the West Virginia Legislature for the creation of new State Parks at Canyon Rim (Region 4), Sandstone Falls (Region 1), Beech Fork Lake (Region 2), and Grave Creek Mound (Region 10, Figure 38).

Table 18. Specially classified areas in the Monongahela National Forest, West Virginia. Ownership data are from US Forest Service (1977). Data are acres.

		OWNERSHIP		
DESIGNATED BY CONGRESS	TOTAL AUTHORIZED EXTENT	Federal Surface	Private Surface	Private Subsurface Mineral
Otter Creek Wilderness Area (P.L. 93-622)	20,000	20,000	0	(19,000+)
Dolly Sods Wilderness Area	10,215	10,215	0	(0)
Cranberry Back Country Wilderness Study Area	36,300	36,300	0	(32,540)
Spruce Knob-Seneca Rocks National Recreation Area (P.L. 89-207)	100,000 (planned 55,000)	9,645	1,955	(2,305)
Seneca Creek Pioneer Area	11,600	2,422	1,178	(1,584)
Hopeville Gorge Pioneer Area	3,600	388	5,712	(5,917)
Smoke Hole Pioneer Area	6,100			
CLASSIFIED BY REGIONAL FORESTER				
Cranberry Glades Botanical Area	750			
Falls of Hills Creek Scenic Area	114			
Gaudineer Scenic Area	140			
Dolly Sods Scenic Area	2,500			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CALHOUN
UPSHUR
RANDOLPH
PENDLETON
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GEORGE
WEBSTER
CABELL
CHARLESTON
POCAHONTAS
NICHOLAS
KANAWHA
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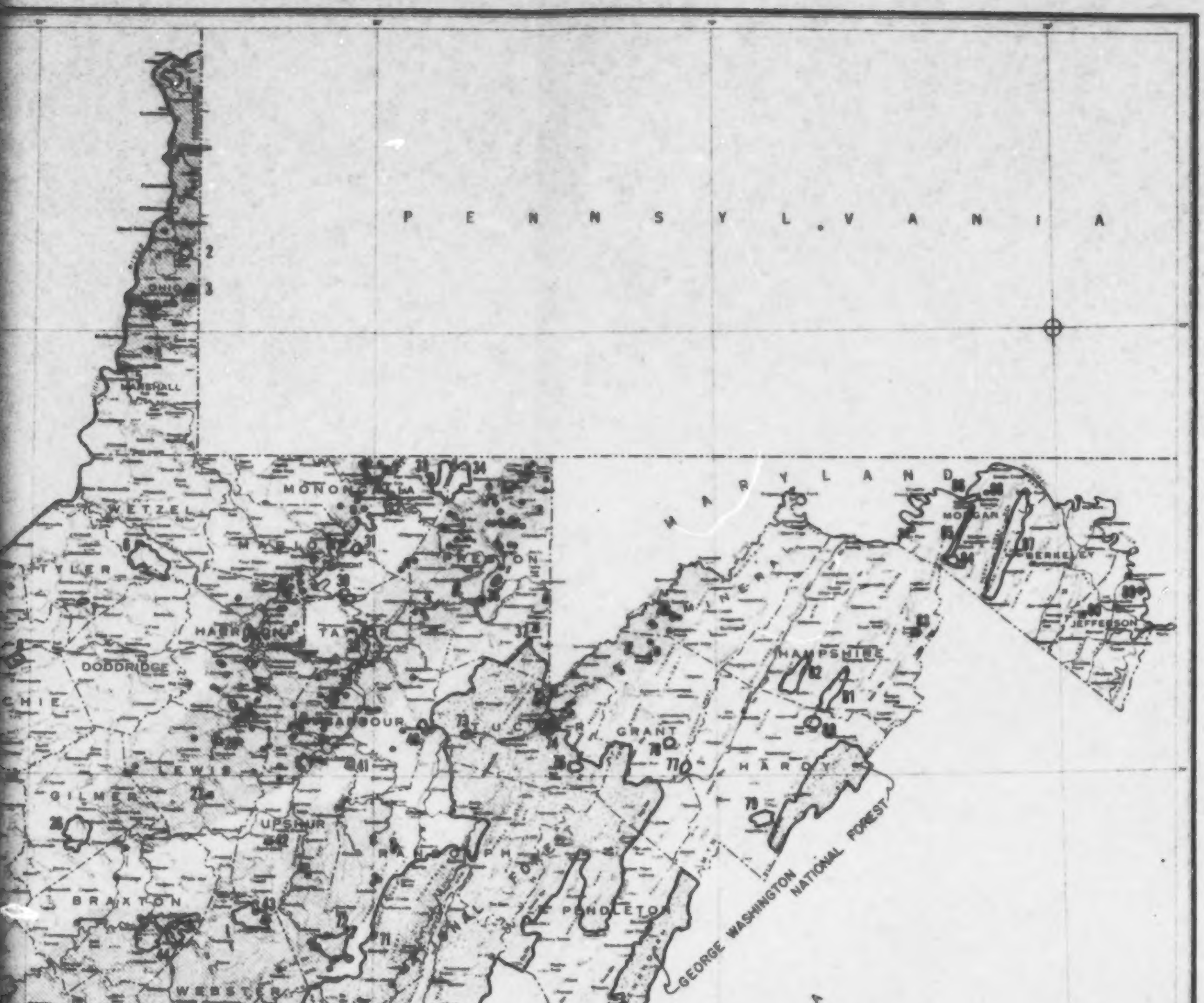
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STATE OF WEST VIRGINIA

SURFACE COAL MINING AREAS, NATIONAL FORESTS, & STATE RECREATIONAL FACILITIES

• ACTIVE SURFACE MINE, 1976.

FIGURE 18

B

The WV-DNR has statutory responsibility to review surface mining permit applications and to prohibit mining adjacent to State lands in order to reduce potential adverse effects.

Private Facilities

Private recreational facilities are of substantial economic importance in West Virginia. An inventory of such facilities conducted by the National Association of Conservation Districts, with the assistance of other organizations and agencies, during 1974 is being processed by the Bureau of Outdoor Recreation (GOFSR 1975). Selected findings from this inventory are presented in Table 20. Combined totals for public and private recreational facilities in West Virginia are presented in Table 21.

Wild and Scenic Rivers

Rivers that possess outstanding scenic, recreational, cultural, or natural values are important State and National resources. Such areas have in the past, and in the future can be, affected adversely by surface coal mining in their watersheds. Specific resources that can be affected include hydrology, water quality, vegetation, wildlife (including fish), recreational opportunities, and aesthetics.

Federal Designation

No West Virginia stream has yet been designated as a wild, scenic, or recreational river under the Wild and Scenic Rivers Act (P.L. 90-542). The Bureau of Outdoor Recreation, however, recommended to Congress during 1975 that the New River Gorge be designated a part of the Federal rivers system administered by the National Park Service (GOFSR 1975). The State concurred in this recommendation. The State Outdoor Recreation Division, together with the Governor of West Virginia, have recommended further that the entire Gorge area be acquired as a part of the National Park System. The plans of the National Park Service have been discussed widely and described in detail (NPS 1976).

State Designation

The West Virginia Legislature enacted the Natural Streams Preservation Act during 1969 (West Virginia Code 20-5-B). This Act established the preservation and protection, in their natural condition, of streams that possess outstanding scenic, recreational, geological, fish and wildlife, botanical, historical, archaeological, or other scientific or cultural values as a public policy of the State. The act established [illegible] permit procedure for the impounding, diverting, or flooding of any stream within the natural stream preservation system. Administrative action by WV-DNR under this act comes under the appeals purview of the Water Resources Board; decisions of the Board can be appealed to the Circuit Court of the affected county, and ultimately to the State Supreme Court. The Act does not address the effects of industrial effluents, such as wastewater from surface coal mines.

Streams which were designated by the Legislature for protection under the Act through 1976 include the following (Figure 19).

1. Greenbrier River from its confluence with Knapps Creek to its confluence with the New River.

2. Anthony Creek from its headwaters to its confluence with the Greenbrier River.

3. Cranberry River from its headwaters to its confluence with the Gauley River.

4. Birch River from the Cora Brown Bridge in Nicholas County to the confluence of the River with the Elk River.

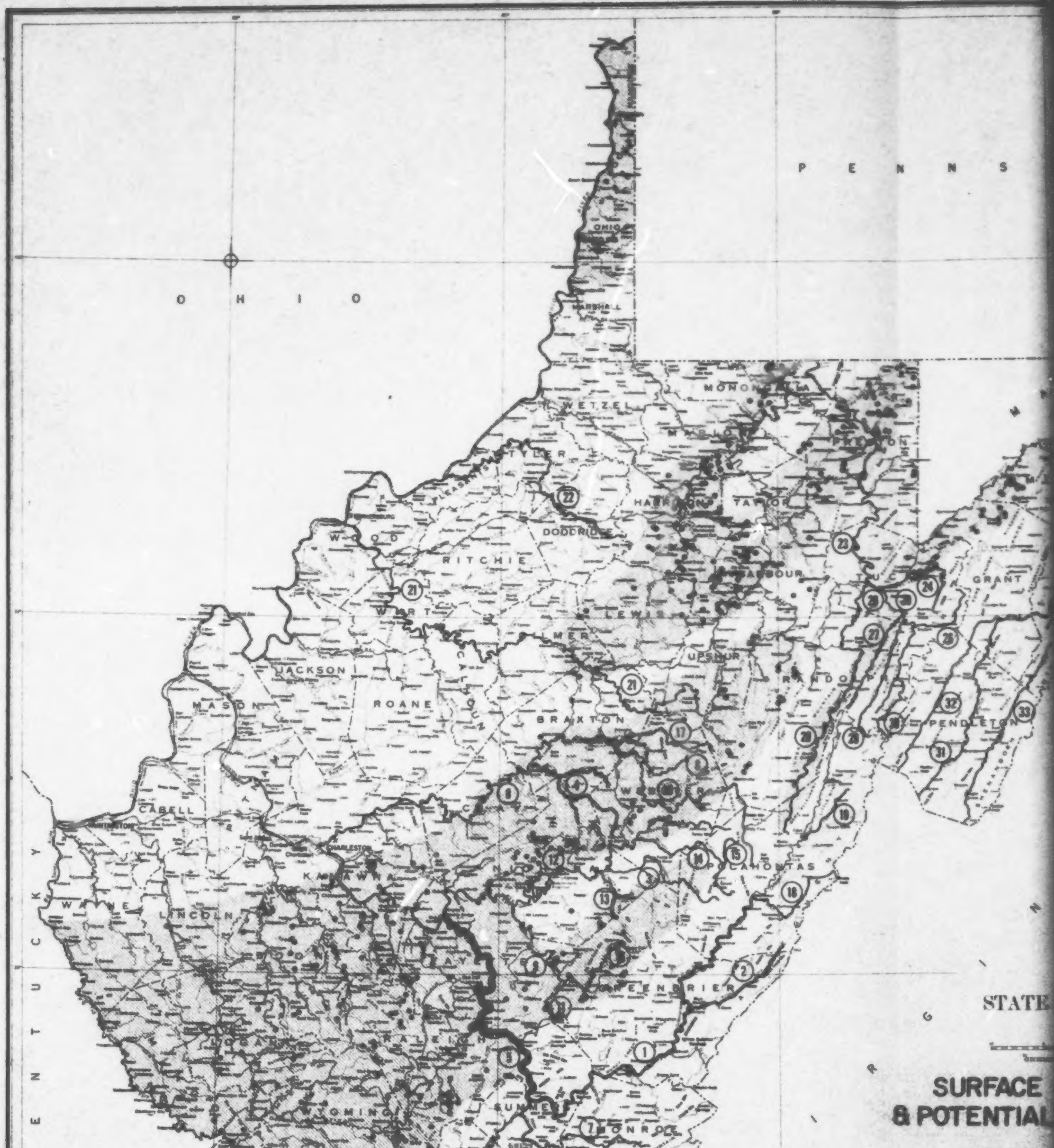
5. New River from its confluence with the Gauley River to its confluence with the Greenbrier River.

At present three State parks have been established along the rim of the New River Gorge, and three additional State parks are in the near vicinity. The State plans to acquire 5,200 acres in the vicinity and to develop two new State parks (GOFSR 1975). Surface mining applications from the vicinity to date have been resisted by the WV-DNR, and the rejections had not been challenged by the mining industry as of late 1976 (Verbally, H. G. Woodrow and R. Mathis, West Virginia Department of Natural Resources, 19 October 1976).

The West Virginia Office of Federal-State Relations and WV-DNR have established preliminary criteria and currently are evaluating other streams for possible inclusion in a new system of State wild, scenic, and recreational rivers (GOFSR 1975). The streams under consideration include the following:

6. Bluestone River
7. Indian Creek
8. Elk River
9. Meadow River
10. Big Clear Creek
11. Little Clear Creek
12. Gauley River
13. Cherry River
14. Williams River
15. Tea Creek
16. Back Fork of Elk River
17. Holly River
18. Knapps Creek
19. Deer Creek
20. Shavers Fork of Cheat River
21, Little Kanawha River
22. Middle Island Creek
23. Cheat River
24. Blackwater River
25. Black Fork River
26. Red Creek
27. Glady Fork of Dry Fork River
28. Laurel Fork of Dry Fork River
29. Dry Fork River
30. Gandy Creek
31. South Branch River
32. North Fork of South Branch River
33. South Fork of South Branch River
34. Little Cacapon River
35. Cacapon River
36. Lost River
37. Sleepy Creek
38. Shenandoah River

All of the streams mentioned in this section are indicated by number on Figure 19.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DODDRIDGE
WOOD
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BARBOUR
TUCKER
GRANT
WIRT
LEWIS
GILMER
UPSHUR
JACKSON
MASON
ROANE
CALHOUN
BRAXTON
RANDOLPH
PENDLETON
WEBSTER
CABELL
CHARLESTON
KANAWHA
POCAHONTAS
WAYNE
LINCOLN
BOONE
GREENBRIER
LOGAN
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SUMMERS
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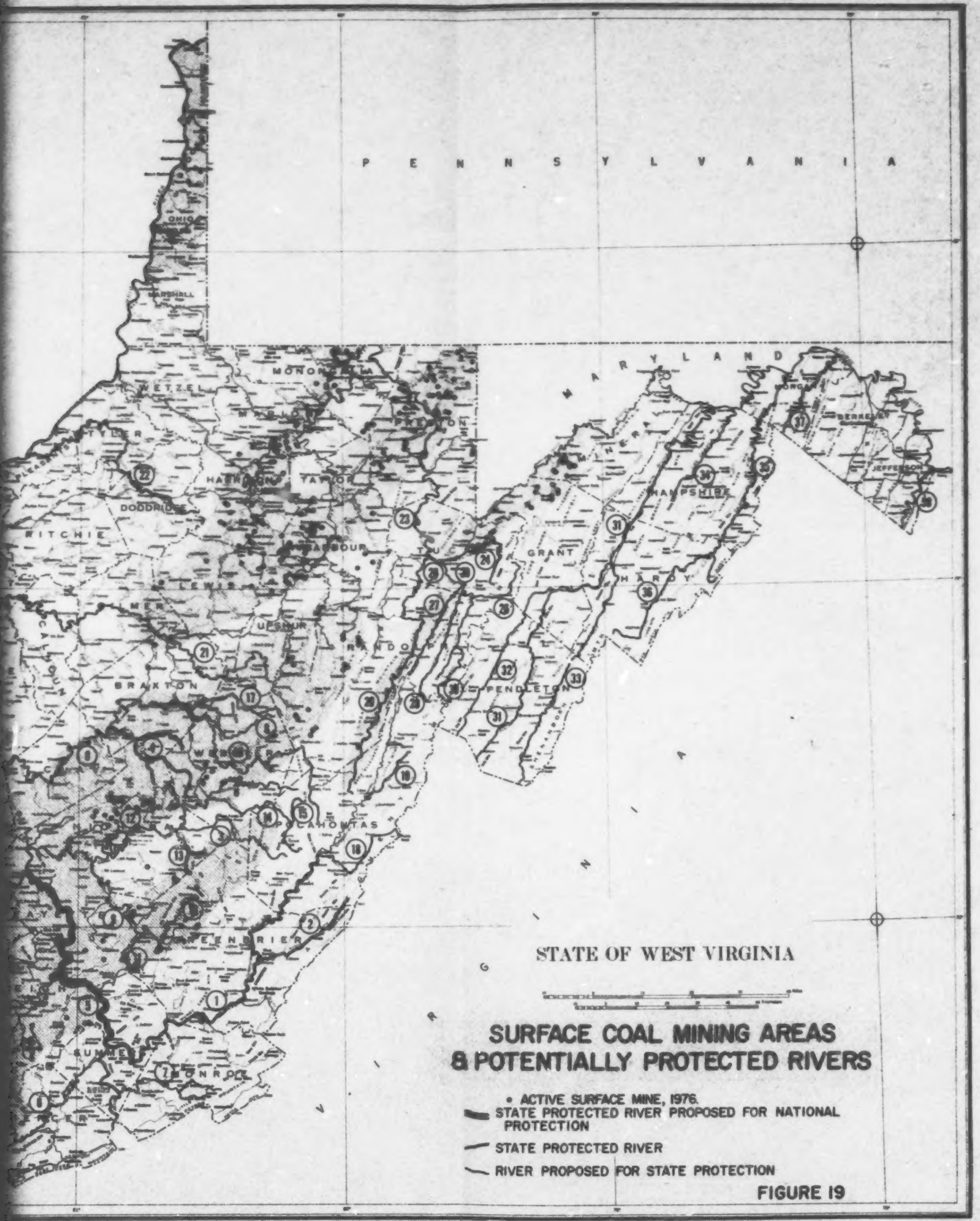
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MERCER
TUCKER
GRANT
MINERAL
HAMPSHIRE
MORGAN
BERKELEY
JEFFERSON
HARDY
PENDLETON

SURFACE COAL MINING AREAS & POTENTIALLY PROTECTED RIVERS

- ● ACTIVE SURFACE MINE, 1976.
- STATE PROTECTED RIVER PROPOSED FOR NATIONAL PROTECTION
- STATE PROTECTED RIVER
- RIVER PROPOSED FOR STATE PROTECTION

FIGURE 19

Table 19. State parks, State forests, and related facilities in West Virginia (GOFSR 1975, WVGS 1966). These facilities are mapped by number in Figure 18. Each facility is listed here for only one county, although several cross county boundaries. Abbreviations: SP, State Park; PFA, Public Fishing Area; PHA, Public Hunting Area; PAS, Public Access Site; FH, Fish Hatchery; WR, Wildlife Refuge; SF, State Forest.

Map No.	County	Name	Acreage
1	Hancock	Tomlinson Run SP	1,398
2	Brooke	Castleman Run PFA	111
3	Ohio	Bear Rock Lake PFA	181
4	Marshall	Birches Run PFA	39
5	Marshall	Grave Creek Mound SP	2
6	Wetzel	Lewis Wetzel PHA	9,126
7	Tyler	Conaway Run PFA	325
8	Ritchie	North Bend SP	1,382
9	Wood	Leachtown PAS	4
10	Wood	Lee Creek PAS	4
11	Wirt	Hughes River PHA	(10,000 leased)
12	Wirt	Palestine FH	127
13	Jackson	Turkey Run Lake PFA	50
14	Mason	Clements State Tree Nursery	-
15	Mason	Point Pleasant Battle Monument	2
16	Mason	C.F. McLintic WR	2,390
17	Mason	Chief Cornstalk PHA	10,115
18	Cabell	Mill Creek PFA	-
19	Cabell	Guyandotte River PAS	10
20	Wayne	Cabwaylingo SF	8,036

Table 19. State parks, State forests, and related facilities in West Virginia (continued).

Map No.	County	Name	Acreage
42	Upshur	French Creek Game Farm	329
43	Webster	Holly River SP	7,702
44	Braxton	Elk River PHA	13,741
45	Webster	Big Ditch PHA	253
46	Nicholas	Carnifex Ferry Battlefield SP	156
47	Fayette	Hawks Nest SP	237
48	Fayette	Babcock SP	3,637
49	Fayette	Plum Orchard PHA	2,955
50	Raleigh	Grandview SP	873
51	Raleigh	Little Beaver SP	385
52	Wyoming	Horse Creek Lake PFA	35
53	Wyoming	Twin Falls SP	3,842
54	McDowell	Panther Creek SF	7,810
55	McDowell	Berwind Lake PFA	46
56	McDowell	Anawalt Lake PFA	302
57	Mercer	Pinnacle Rock SP	244
58	Mercer	Camp Creek SF	5,897
59	Summers	Pipestem SP	4,004
60	Summers	Bluestone SP	211
		Bluestone PHA	(19,886 leased)
61	Monroe	Moncove Lake PFA	126
62	Greenbrier	Greenbrier SF	5,061
63	Greenbrier	Calvin W. Price SF	9,482
64	Pocahontas	Watoga SP	10,057

Table 19. State parks, State forests, and related facilities in West Virginia (concluded).

Map No.	County	Name	Acreage
65	Pocahontas	Beartown SP	107
66	Pocahontas	Droop Mountain Battlefield SP	278
67	Pocahontas	Edray Trout Hatchery	29
68	Pocahontas	Williams River PHA	784
69	Pocahontas	Seneca SF	11,686
70	Pocahontas	Cass Scenic Railroad SP	230
71	Randolph	Camp Elkwater SP	10
72	Randolph	Kumbrabow SF	9,431
73	Tucker	Parsons Nursery SF	-
74	Tucker	Blackwater Falls	1,688
75	Tucker	Fairfax Stone Monument SP	4
76	Tucker	Canaan Valley SP	6,681
77	Grant	Spring Run Trout Hatchery	42
78	Grant	Petersburg Trout Hatchery	9
79	Hardy	Lost River SP	3,680
80	Hardy	Warden Lake PFA	87
81	Hampshire	Short Mountain PHA	8,020
82	Hampshire	Nathaniel Mountain PHA	8,876
83	Hampshire	Edwards Run PFA	393
84	Morgan	Ridge Trout Hatchery	29
85	Morgan	Cacopon SP	3,107
86	Morgan	Cacopon River PAS	22
87	Morgan	Sleepy Creek PHA	22,630
88	Morgan	Berkeley Springs SP	7
89	Morgan	James Rumsey Monument SP	4

Table 20. Inventory of selected private recreational facilities in West Virginia, by State Planning Region, conducted by the National Association of Conservation Districts during 1974 (GOFSR 1975). State Planning Regions are defined in Figure 38. ORV indicates off-road vehicle.

Region	CAMPING SITES		Fishing Acres	Golf Holes Regulation	Hunting Acres	Picnic Tables	TRAIL MILES				Pools (sq.ft)	Tennis Courts
	Transient	Vacation					Bicycle	Hiking	Horse	ORV		
1	630	110	28	63	750	314	0	29	9	20	18,812	7
2	203	167	35	108	3,759	165	0	63	5	2	22,696	27
3	64	31	129	126	13,340	632	5	48	47	10	129,165	25
4	375	576	95	72	17,200	365	7	268	210	17	37,754	33
5	324	89	123	144	30,741	495	4	26	21	0	54,100	26
6	505	665	141	243	12,595	341	0	11	8	6	18,925	16
7	201	306	38	63	5,492	101	0	9	27	8	26,925	7
8	254	1,013	368	54	11,591	189	0	50	54	0	3,640	0
9	432	1,427	100	36	15,729	511	0	36	12	1	51,425	14
10	139	75	12	36	1,275	319	0	3	0	0	8,100	1
11	30	0	20	53	804	171	0	12	9	0	13,200	100
Total	3,057	4,459	1,089	998	113,276	3,653	16	555	402	64	384,942	116

Table 21. Public and private recreational facilities in West Virginia, by State Planning Region, inventoried by the National Association of Conservation Districts during 1974 (GOFSR 1975). State Planning Regions are defined in Figure 38.

Region	Impoundment Boating Acres	Fishing (Acres)	Golf Holes	Hunting (Acres)	Picnicking Tables	Tennis Courts	Swim Beaches (Land Acres)	Pools (sq.ft.)	Camping Sites	Foot Trails	Bike Trails	Horse Trails
1	2,349	2,663	108	33,873	1,861	19	4	60,862	878	86	13	27
2	1,100	1,150	109	40,516	619	42	1	81,336	194	92	0	5
3	32	164	180	28,787	1,471	69	0	173,665	60	79	12	47
4	3,338	3,638	81	523,592	1,218	35	2	74,454	664	358	7	217
5	65	188	144	40,716	1,094	34	0	87,300	238	32	4	21
6	1,826	1,971	243	26,570	1,085	28	5	45,125	104	38	2	17
7	1,584	1,624	90	284,834	819	7	3	38,245	507	65	0	31
8	40	442	54	202,826	554	11	1	18,410	536	97	0	57
9	211	311	54	37,729	878	22	1	61,225	342	78	0	16
10	38	51	117	1,275	1,008	36	0	67,600	80	12	2	3
11	62	82	53	954	416	21	0	41,325	0	22	0	15
Total	10,645	12,284	1,232	1,221,672	11,023	324	17	749,547	3,603	959	40	456

Water Resources

Surface mining of coal can affect adversely the water resources of a region by degrading chemical water quality parameters such as acidity and metals concentrations, as well as by adding significant quantities of sediment either as suspended solids or as bed load. The water resources impacted may include lakes, streams, and groundwater resources. The Director of the WV-DNR must delete from surface mining permit applications any areas within 100 feet of public facilities, and may delete other areas if mining in them is expected to affect public facilities adversely (West Virginia Code 20-6-11). The major impoundments constructed by the Corps of Engineers and other waterways throughout the mining regions in the past have been degraded seriously by sediment and by acid mine drainage from the coal mining industry in West Virginia (Verbally, Lt. Col. John R. Hill, Assistant Director of Civil Works Environmental Programs, Army Corps of Engineers, Washington DC, 16 February 1977).

High Quality Streams

Streams of high quality have been identified by the Division of Wildlife Resources, WV-DNR, in consultation with the Soil Conservation Service (WV-DNR 1974). There are about 8,000 streams in West Virginia with 7,580 miles that support fish populations. Of this total mileage about 91% (6,870 miles) are classed as warm water habitats.

The following criteria were used by WV-DNR to identify the 410 high-quality streams of West Virginia:

(1) All streams which contain native trout populations.

(2) All streams which are stocked with trout (167 streams).

(3) Warmwater streams more than 5 miles long which have both desirable fish populations and public use.

WV-DNR pays special attention to surface mining applications that may affect the streams designated as high-quality (Table 22, Figure 20). Nevertheless, some of these streams are polluted by acid mine drainage (cf. Figure 21 and Table 25).

Trout Waters

West Virginia Water Quality Regulations designate numerous streams, stream stretches, lakes, reservoirs, and ponds as Trout Waters (Table 23). This designation is made because trout (Family Salmonidae) are quite sensitive to environmental stresses, and they represent a wildlife resource of great recreational and economic importance to the State.

Trout are cold water species and inhabit water with temperatures less than 70°F. (21°C). Spawning usually occurs from late winter to early spring in clean, gravelly riffles and requires temperatures of approximately 50°F. (10°C). The continued propagation of trout populations in the waters of West Virginia depends upon control of water quality and habitat suitability in areas where trout currently are found. The preservation of sediment-free spawning areas is of the utmost importance.

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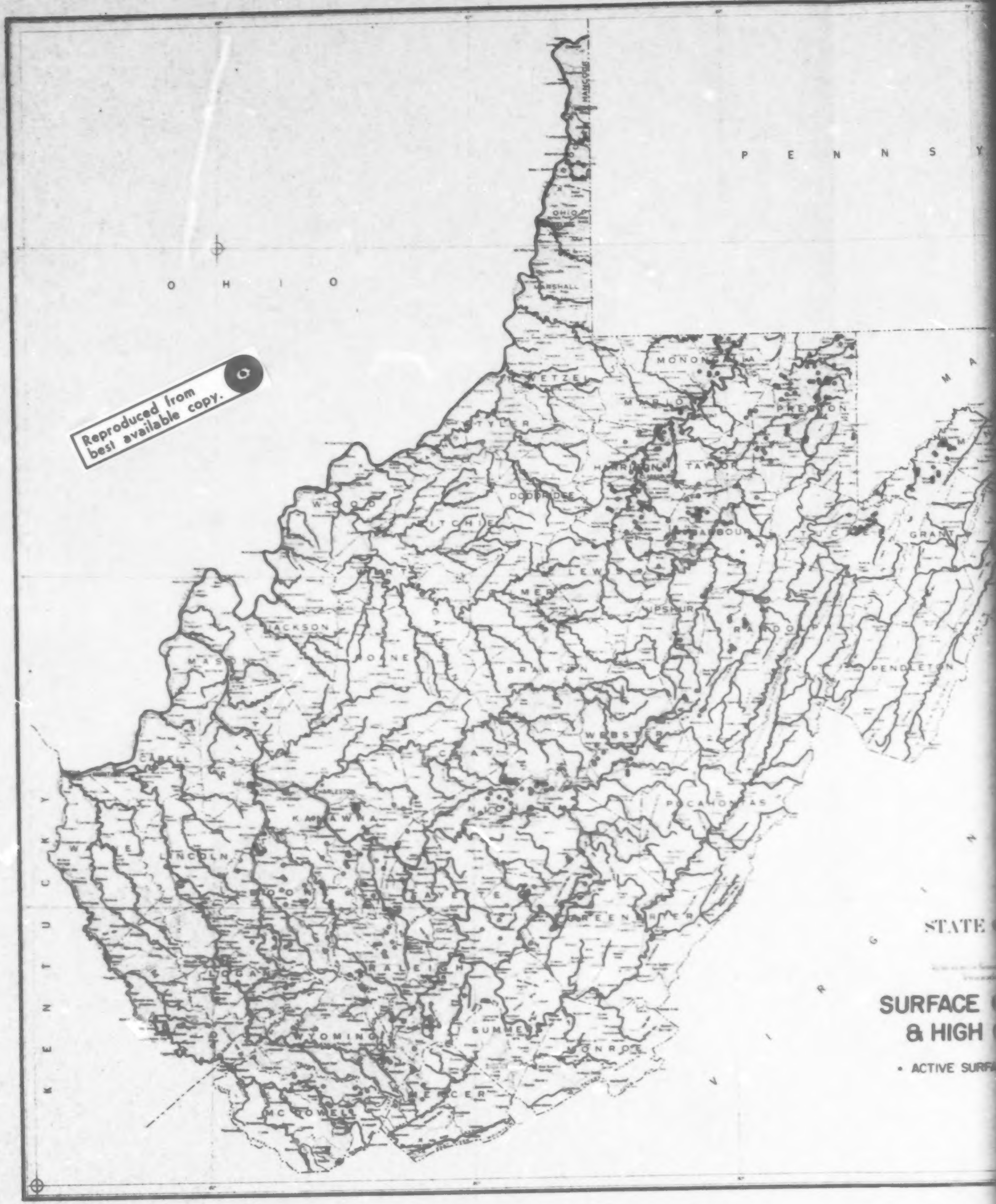
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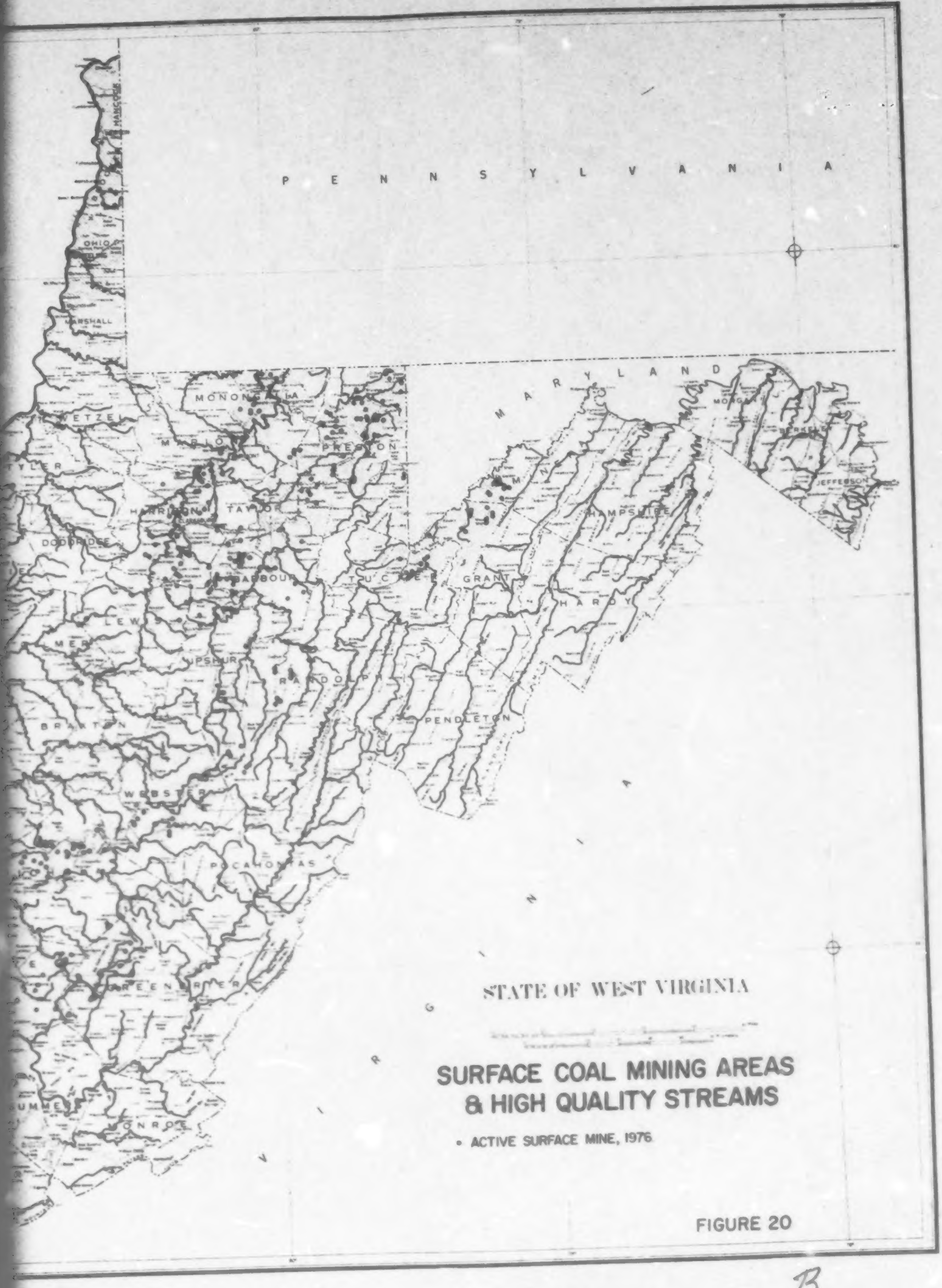
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WEBSTER
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GREENBRIER
UMMER
MONROE
VIRGINIA

STATE OF WEST VIRGINIA

SURFACE COAL MINING AREAS
& HIGH QUALITY STREAMS

• ACTIVE SURFACE MINE, 1976

FIGURE 20

B

Table 22. High quality streams of West Virginia, based on fishable resources (WV-DNR 1974). Alphabetic and numeric codes refer to standard code adopted by USGS and WV-DNR. Alphabetic codes refer to stream names. Numeric codes refer to stream miles from mouth to river mile where tributaries enter mainstem.

BIG SANDY RIVER SYSTEM

- Tug Fork River BST
    - Pigeon Creek BST-24
        - Trace Fork BST-24-K
    - Panther Creek BST-60
    - Dry Fork BST-70
    - Clear Fork BST-76

JAMES RIVER SYSTEM

- Potts Creek J-1
    - Trout Branch J-1-B
    - North Fork Potts Creek J-1-C
    - South Fork Potts Creek J-1-E

KANAWHA RIVER SYSTEM

- Kanawha River K
    - Threemile Creek K-5
    - Tenmile Creek K-10
    - Thirteenmile Creek K-12
    - Sixteenmile Creek K-14
    - Eighteenmile Creek K-16
    - Five and Twentymile Creek K-19
    - Hurricane Creek K-22

    - Pocatalico River KP
        - Left Fork Pocatalico River KP-17
            - Middle Fork Pocatalico River KP-17-B
        - Flat Fork KP-33
    - Coal River KC
        - Little Coal River KC-10
            - Spruce Fork KC-10-T
                - Spruce Laurel Fork KC-10-T-11
            - Pond Fork KC-10-U
        - Marsh Fork KC-46

Table 22. High quality streams of West Virginia (continued).

- Elk River KE
    - Little Sandy Creek KE-9
    - Blue Creek KE-14
    - Big Sandy Creek KE-23
    - Laurel Creek KE-37
    - Little Sycamore Creek KE-40
    - Sycamore Creek KE-41
    - Leatherwood Creek KE-46
    - Lilly Fork KE-50-B
    - Beech KE-50-B-8
    - Sand Fork KE-50-F
    - Flat Fork KE-50-i-1
    - Robinson Fork KE-50-O

- Otter Creek KE-64
    - Bogg Fork KE-64-E
- Grove Creek KE-69
- Strange Creek KE-74
- Birch River KE-76
    - Little Birch River KE-76-E
    - Anthony Creek KE-76-N
    - Poplar Creek KE-76-O
    - Strange Creek KE-39
    - Rock Camp Run KE-82
    - Wolf Creek KE-91
- Holly River KE-98
    - Right Fork Holly River KE-98-B
    - Left Fork Holly River KE-98-C
    - Desert Fork KE-98-B-16
    - Old Lick Creek KE-98-C-2
    - Laurel Fork KE-98-C-11
        - Fall Run KE-98-C-14
- Back Fork Elk River KE-111
    - Sugar Creek KE-111-K
        - Little Sugar Creek KE-111-K-2
- Dry Fork KE-133
- Big Run KE-135
- Props Run KE-136
- Cupp Run KE-138-B
- Old Field Run KE-139
- Crooked Fork KE-139-B
- Slaty Fork KE-140

- Loop Creek K-76

Table 22. High quality streams of West Virginia (continued).

- Gauley River KG
  - Twentymile Creek KG-5
  - Otter Creek KG-13-B
  - Meadow River KG-19
    - Anglins Creek KG-19-G
    - Wolfpen Creek KG-19-Q-2
    - Big Clear Creek KG-19-U
      - South Fork KG-19-U-2
    - Little Clear Creek KG-19-V
      - Laurel Creek KG-19-V-5
      - Hominy Creek KG-24
      - Deer Creek KG-24-B
  - Cherry River KG-34
    - Laurel Creek KG-34-E
    - Little Laurel Creek KG-34-F
    - Improvement Branch KG-34-F-2
    - South Fork Cherry River KG-34-G
    - North Fork Cherry River KG-34-H
  - Cranberry River KGC
    - South Fork Cranberry River KGC-23
    - North Fork Cranberry River KGC-24
  - Williams River KGW
    - Tea Creek KGW-20

- New River KN
  - Laurel Creek KN-5
  - Mill Creek KN-7
  - Wolf Creek KN-10
  - Glade Creek Mann Creek KN-17-A
  - Piney Creek KN-26
  - Glade Creek KN-29
    - Pinch Creek KN-29-E
  - Meadow Creek KN-32
  - Turkey Creek KN-51-0
  - Indian Creek KN-51
    - Laurel Creek of Indian Creek KN-51-1
  - East River KN-60
    - Pigeon Creek KN-60-B
  - Rich Creek KN-61

Table 22. High quality streams of West Virginia (continued).

- Greenbrier River KNG
  - Milligan Creek KNG(S)-1
  - Sinking Creek KNG(S)-2
  - Culverson Creek KNG(S)-3
  - Burns Creek KNG(S)-3-A
  - Roaring Creek KNG(S)-3-C-1
  - Hills Creek KNG(S)-4
  - Wolf Creek KNG-7
  - Wolf Creek KNG-18
  - Muddy Creek KNG-22
  - Second Creek KNG-23
  - Anthony Creek KNG-28
    - Meadow Creek KNG-28-P
      - Laurel Run KNG-28-P-1
    - North Fork Anthony Creek KNG-28-Q
  - Laurel Run KNG-29
  - Spring Creek KNG-30
  - Locust Creek KNG-38
  - Laurel Run KNG-40
  - Beaver Creek KNG-47
  - Swago Creek KNG-49
  - Knapps Creek KNG-53
    - Brown Creek KNG-53-C
  - Stoney Creek KNG-55
  - Sitlington Creek KNG-66
  - Deer Creek KNG-68
    - North Fork Deer Creek KNG-68-A
  - East Fork Greenbrier River KNG-78
    - Little River KNG-78-C
    - Fivemile Run KNG-78-G
    - Mullenax Run KNG-78-C
    - Abes Run KNG-78-L
  - West Fork Greenbrier River KNG-79
    - Little River KNG-79-C

- Bluestone River KNB
  - Mountain Creek KNB-5
  - Camp Creek KNB-13
  - Mash Fork KNB-13-D

Table 22. High quality streams of West Virginia (continued).

LITTLE KANAWHA RIVER SYSTEM

- Little Kanawha River LK
    - Worthington Creek LK-2
    - Tygart Creek LK-6
    - Stillwell Creek LK-7
    - Walker Creek LK-10
    - Hughes River LKH
        - Goose Creek LKH-4
        - South Fork Hughes River LKH-9
            - Indian Creek LKH-9-J
            - Leatherbark Creek LKH-9-M
            - Spruce Creek LKH-9-R
            - Slab Creek LKH-9-W
            - Bone Creek LKH-9-X
            - Middle Fork Hughes River LKH-9-AA
    - North Fork Hughes River LKH-10
        - Devilhole Creek LKH-10-G
        - Bonds Creek LKH-10-R
            - Hushers Run LKH-10-R-1
    - Standingstone Creek LK-21
    - Tucker Creek LK-23
    - Reedy Creek LK-25
        - Right Reedy Creek LK-25-B
        - Middle Fork Reedy Creek (no code)

    - West Fork Little Kanawha LKW
        - Henry Fork LKW-15
        - Beech Fork LKW-15-J

    - Steer Creek LKS
        - Bear Fork LKS-8
        - Right Fork Steer Creek LKS-9
        - Left Fork LKS-14

    - Spring Creek LK-31
    - Straight Creek LK-39
    - Leading Creek LK-40
    - Tanner Creek LK-66
    - Cedar Creek LK-72
    - Leading Creek LK-75
        - Cove Creek LK-75-K
        - Fink Creek LK-75-N
    - Sand Fork LK-86

Table 22. High quality streams of West Virginia (continued).

Little Kanawha River (cont'd)

- Oil Creek LK-94
- Saltlick Creek LK-95
- Right Fork Little Kanawha River LK-115
  - Left Fork Right Fork Little Kanawha LK-115-H

MONONGAHELA RIVER SYSTEM

Monongahela River M

Cheat River MC

- Morgan Run MC-2
  - Darnell Run MC-2-A-1
  - Blaney Hollow MC-2-B
- Quarry Run MC-6
- Big Sandy Creek MC-12
  - Little Sandy Creek MC-12-B
  - Beaver Creek MC-12-B-1
- Laurel Run MC-15
- Muddy Creek MC-17
- Roaring Creek MC-18
- Elsey Run MC-20
- Saltlick Creek MC-32
  - Spruce Fork MC-32-B
- Buffalo Creek MC-33
  - Little Buffalo Creek MC-33-D
- Wolf Creek MC-32
- Clover Run MC-51
- Horseshoe Run MC-54
  - Maxwell Run MC-54-C
- Slip Hill Mill Run MC-56
- Dry Fork MC-60
  - Black Fork (no code)
  - Elklick Run MC-60-C
  - Blackwater River MC-60-D
    - Little Blackwater River MC-60-D-8
  - Otter Creek MC-60-F
  - Glady Fork MC-60-K
    - Three Springs MC-60-K-1
    - East Fork Glady Fork MC-60-K-17
  - Big Run MC-60-L
  - Laurel Fork MC-60-N
  - Camp Five Run MC-60-N-10
  - Red Creek MC-60-0
  - Gandy Creek MC-60-T

Table 22. High quality streams of West Virginia (continued).

- Cheat River (Cont'd)
    - Shavers Fork MCS
        - Little Black Fork MCS-13

    - Dunkard Creek M-1
        - West Virginia Fork of Dunkard Creek M-1-F
    - Cobun Creek M-9
    - Whiteday Creek M-16
    - Pricketts Creek M-10
    - Paw-Paw Creek M-22
    - Buffalo Creek M-23

- Tygart River MT
    - Wickwire Run MT-8
    - Three Forks Creek MT-12
    - Pleasants Creek MT-15
    - Teter Creek MT-23
        - Brushy Fork MT-23-C
        - Mill Run MT-23-F
    - Laurel Run MT-24
    - Leading Creek MT-43
    - Chenoweth Creek MT-45
    - Files Creek MT-50
    - Mill Creek MT-64
    - Beckys Creek MT-68
    - Elkwater Fork MT-74
    - Stewart Run MT-75
    - Big Run MT-81

    - Buckhannon River MTB
        - French Creek MTB-18
        - Tenmile Creek MTB-25
        - Panther Creek MTB-27
        - Right Fork Buckhannon MTB-31
            - Left Fork Right Fork Buckhannon MTB-31-F
        - Left Fork Buckhannon MTB-32

    - Middle Fork River MTM
        - Right Fork Middle Fork River MTM-21

    - West Fork River MW
        - Booths Creek MW-2
        - Corbin Branch MW-2-E
        - Tenmile Creek MW-13
            - Little Tenmile Creek MW-13-B

Table 22. High quality streams of West Virginia (continued).

- Tygart River (cont'd)
    - Elk Creek MW-21
    - Hackers Creek MW-31
    - Freemans Creek MW-36
    - Stonecoal Creek MW-38
        - Right Fork MW-38-G
    - Skin Creek MW-46

OHIO RIVER SYSTEM

- Ohio River O
    - Twelvepole Creek O-2
        - Beech Fork O-2-H
        - West Fork Twelvepole Creek O-2-P
        - East Fork Twelvepole Creek O-2-Q

    - Guyandotte River OG
        - Mud River OGM
            - Trace Fork OGM-20
            - Middle Fork OGM-25
        - Big Ugly Creek OG-38
        - Laurel Fork OGC-16
        - Buffalo Creek OG-75
        - Big Huff Creek OG-76
        - Indian Creek OG-110
        - Pinnacle Creek OG-124

    - Guyan Creek O-9
    - Eighteenmile Creek O-10
    - Sixteenmile Creek O-11
    - Crab Creek O-13
    - Oldtown Creek O-21
    - Mill Creek O-32
        - Tug Fork O-32-L
        - Elk Fork O-32-M
        - Little Mill Creek O-32-N
            - Frozencamp Creek O-32-N-3
    - Sandy Creek O-36
    - Little Sandy Creek O-38
    - Pond Creek O-43
        - Little Pond Creek O-43-D
    - Lee Creek O-44
        - South Fork O-44-A
        - Middle Fork O-44-A-1
        - North Fork O-44-B

Table 22. High quality streams of West Virginia (continued).

Ohio River (cont'd)

- Bull Creek O-53
- Calf Creek O-54
- Cow Creek O-55
- French Creek O-57

- Middle Island Creek OMi
  - McKim Creek OMi-4
  - Sugar Creek OMi-9
  - Point Pleasants Creek OMi-23
  - Indian Creek OMi-29
  - McElroy Creek OMi-30
    - Flint Run OMi-30-H
    - Talkington Fork OMi-30-N
  - Arnolds Creek OMi-40
  - Bluestone Creek OMi-43
  - Meathouse Fork OMi-46
    - Toms Fork OMi-46-E
  - Buckeye Creek OMi-47
- Fishing Creek O-69
  - Little Fishing Creek O-69-C
  - South Fork Fishing Creek O-69-N
  - North Fork Fishing Creek O-69-O
- Proctors Creek O-72
- Fish Creek O-77
  - West Virginia Fork Fish Creek O-77-O
    - Knob Fork O-77-O-3
  - Pennsylvania Fork Fish Creek O-77-P
- Grave Creek O-83
- Wheeling Creek O-88
  - Middle Wheeling Creek O--8-D-2
- Buffalo Creek O-92
- Cross Creek O-95
- Kings Creek O-98
  - North Fork Kings Creek O-98-A
- Tomlinson Run O-102

POTOMAC RIVER SYSTEM

- Town Run (no code)
- Rocky Marsh Run P-3
- Opequon Creek P-4
  - Tuscarora Creek P-4-C
  - Middle Creek P-4-J
  - Mill Creek P-4-M

Table 22. High quality streams of West Virginia (continued).

POTOMAC RIVER SYSTEM (Cont'd)

- Harlan Run P-5
- Back Creek P-6
    - Tilhance Creek P-6-A
    - Mill Run (no code)
- Sleepy Creek P-9
    - Middle Fork Sleepy Creek
    - Meadow Branch P-9-B
- Cacapon River PC
    - North River PC-7
        - Hiett Run PC-7-C
        - Tearcoat Creek PC-7-F
    - Cold Stream PC-9
    - Edwards Run PC-10
    - Dillons Run PC-11
    - Moores Run PC-20
    - Waites Run PC-22
    - Trout Run PC-23
    - Lost River PC-24
        - Camp Branch PC-24-E-1
        - Lower Cove Run PC-24-H
- Sir Johns Run P-12
- Little Cacapon River P-19

- Patterson Creek PNB-4
    - Grayson Gap Run PNB-4-D
    - North Fork Patterson Creek PNB-4-EE
- New Creek PNB-7
- Howell Run PNB-14
- Stoney River PNB-17
- Difficult Creek PNB-18
- Big Buffalo Creek PNB-19
    - Little Buffalo Creek PNB-19-A
- South Branch PSB
    - Mill Creek PSB-9
    - Mill Run PSB-13
    - South Fork PSB-21
        - Dumpling Run PSB-21-F
        - Little Fork PSB-21-GG
    - Mill Creek PSB-25
        - Brushy Run PSB-25-B-2
        - South Mill Creek PSB-25-C
            - Spring Run PSB-25-C-2

Table 22. High quality streams of West Virginia (concluded).

- South Branch (cont'd)
  - Lunice Creek PSB-26
    - South Fork Lunice Creek PSB-26-D
      - Big Star Run PSB-26-D-2
    - North Fork Lunice Creek PSB-26-E
  - North Fork PSB-28
    - Jordan Run PSB-28-A
    - Big Run PSB-28-A-1
    - Laurel Run PSB-28-14-2
    - Seneca Creek PSB-28-K
      - Roaring Creek PSB-28-K-2
      - White Run PSB-28-K-6
    - Big Run PSB-28-EE
    - Laurel Fork PSB-28-GG
    - Thorn Creek PSB-47
      - Black Thorn Creek PSB-47-B
      - White Thorn Creek PSB-47-C

SHENANDOAH RIVER SYSTEM

- Shenandoah River S
  - Flowing Springs Run S-1
  - Cattail Run S-2
  - Evitts Run S-4
  - Big Bullskin Run S-6
    - North Fork Bullskin Run S-6-A
  - Long Marsh Run S-7

Table 23. Trout waters of West Virginia (West Virginia Administrative Regulations, State Water Resources Board, Effective 15 April 1974). The officially designated trout waters include, but are not limited to, the listed bodies of water.

Stream	County
Abes Run	Pocahontas
Anglins Creek	Nicholas
Anthony Creek	Greenbrier
Back Fork, Elk River	Webster
Beaver Creek	Pocahontas
Big Bullskin Run	Jefferson
Big Clear Creek	Greenbrier
Big Huff Creek	Logan, Wyoming
Big Run	Pendleton
Big Run	Randolph
Big Sandy Creek	Preston
Blackwater River	Tucker
Blaney Hollow & Morgan Run	Monongalia
Brushy Fork	Barbour
Buckhannon River	Upshur
Buffalo Creek	Preston
Camp Branch	Hardy
Camp Creek	Mercer
Camp Five Run	Randolph
Cattail Run	Jefferson
Cherry River	Nicholas
Clear Fork	McDowell
Clover Run	Tucker
Cold Stream	Hampshire
Cranberry River	Pocahontas, Webster, Nicholas
Cross Creek	Brooke
Culverson Creek	Greenbrier
Deer Creek	Nicholas
Deer Creek	Pocahontas
Desert Fork	Webster
Dillons Run	Hampshire
Dry Fork	McDowell
Dry Fork	Randolph, Tucker
Dumpling Run	Hardy
East Fork, Glady Fork	Randolph

Table 23. Trout waters of West Virginia (continued).

Stream	County
East Fork, Greenbrier River	Pocahontas
East River, New River	Mercer
Edwards Run & Pond	Hampshire
Elklick Run	Tucker
Elk River, Slaty Fork	Pocahontas
Elk River (Webster Springs)	Webster
Elk River (Whit. F)	Webster, Randolph
Elkwater Fork	Randolph
Elsey Run	Preston
Evitts Run	Jefferson
Five Mile Run	Pocahontas
Flowing Springs Run	Jefferson
Fall Run	Webster
Gandy Creek	Randolph
Gauley River (Head)	Randolph, Webster
Glade Creek (Babcock)	Fayette
Glade Creek, New River	Raleigh
Glady Fork	Randolph
Grave Creek	Marshall
Harlan Run	Berkeley
Hills Creek	Pocahontas
Horseshoe Run	Tucker
Kings Creek	Hancock
Knapps Creek	Pocahontas
Laurel Creek	Fayette
Laurel Creek	Greenbrier, Nicholas
Laurel Creek	Monroe
Laurel Fork	Pendleton
Laurel Fork	Randolph
Laurel Fork	Webster
Laurel Run	Greenbrier
Laurel Run	Pocahontas
Laurel Run	Preston
Left Fork, Buckhannon River	Upshur
Left Fork, Holly River	Webster
Left & Right Forks, Buckhannon R.	Upshur
Left & Right Forks, Little Kanawha River	Upshur
Little Clear Creek & Laurel Run Trib.	Greenbrier
Little Fork	Pendleton
Little Kanawha River (Head)	Upshur, Lewis

Table 23. Trout waters of West Virginia (continued)

Stream	County
Little River (East Fork)	Pocahontas
Little River (West Fork)	Pocahontas
Long Marsh Run	Jefferson
Lost River	Hardy
Lower Cove Run	Hardy
Marsh Fork	Raleigh
Mash Fork	Mercer
Maxwell Run	Tucker
Meadow Branch	Morgan
Meadow Creek	Greenbrier
Meadow Creek	Summers
Middle Creek	Berkeley
Middle Fork River	Barbour, Randolph, Upshur
Mill Creek (Grayson Gap)	Mineral
Mill Creek	Fayette
Mill Creek	Berkeley
Mill Creek	Hampshire
Mill Creek	Randolph
Mill Run	Barbour
Mill Run	Berkeley
Mill Run	Hampshire
Milligan Creek	Greenbrier
Moores Run	Hardy
Mullenax Run	Pocahontas
New Creek	Mineral
North River	Hardy
North Fork, Anthony Creek	Greenbrier
North Fork, Cherry River	Greenbrier, Nicholas
North Fork, Deer Creek	Pocahontas
North Fork, Fishing Creek Dam	Wetzel
North Fork, Lunice Creek	Grant
North Fork, Patterson Creek	Grant
North Fork, South Branch	Pendleton, Grant
Opequon Creek	Berkeley, Jefferson
Paint Creek	Fayette
Panther Creek	McDowell
Paw Paw Creek	Marion
Pigeon Creek	Mercer
Pinch Creek	Raleigh
Pinnacle Creek	Wyoming

Table 23. Trout waters of West Virginia (continued)

Stream	County
Red Creek	Tucker
Rich Creek	Monroe
Right Fork, Buckhannon River	Upshur, Randolph
Right Fork, Little Kanawha River	Webster, Upshur
Right Fork, Middle Fork River	Upshur
Roaring Creek	Preston
Rocky Marsh Run	Jefferson
Saltlick Creek	Preston
Seneca Creek	Pendleton
Shavers Fork	Randolph
Shavers Fork (Lower Section)	Randolph
Shavers Fork (Upper Section)	Randolph, Pocahontas
Sitlington Creek	Pocahontas
Slip Hill Mill Run	Tucker
South Branch (Franklin Section)	Pendleton
South Branch (Smoke Hole Section)	Pendleton
South Fork, Cherry River	Greenbrier, Nicholas
South Fork, Cranberry River	Pocahontas
South Fork, Fishing Creek	Wetzel
South Fork, Lunice Creek	Grant
South Fork, Potts Creek	Monroe
South Mill Creek	Grant
Spring Creek	Greenbrier
Spring Run	Grant
Spruce Laurel Fork	Boone
Stoney Creek	Pocahontas
Sugar Creek	Webster
Summersville Lake (Tailwaters)	Nicholas
Sutton Lake (Tailwaters)	Braxton
Swago Creek	Pocahontas
Tea Creek	Pocahontas
Three Spring Run	Randolph
Tillhance Creek	Berkeley
Tomlinson Run	Hancock
Town Run or 76 Stream	Jefferson
Trout Run	Hardy
Turkey Creek	Monroe
Tuscarora Creek	Berkeley
Tygart River (Head)	Randolph
Waites Run	Hardy

Table 23. Trout waters of West Virginia (concluded)

Stream	County
West Fork, Greenbrier River	Pocahontas
West Fork, Twelvepole Creek	Wayne
Wheeling Creek	Marshall, Ohio
Whiteday Creek	Marion, Monongalia
Wickwire Creek	Taylor
Williams River	Pocahontas, Webster
Wolf Creek	Fayette
Wolf Creek	Preston
Wolfpen Creek	Fayette
Lakes and Ponds	
Bear Rock	Ohio
Berwind	McDowell
Buffalo Fork	Pocahontas
Burches	Marshall
Cacapon	Morgan
Castleman Run	Brooke
Chief Logan	Logan
Conaway	Tyler
Coopers Rock	Monongalia
Dents Run	Marion
Edwards Run	Hampshire
Fitzpatrick	Raleigh
Fort Ashby	Mineral
French Creek	Upshur
Hawse Run	Pendleton
Horse Creek	Wyoming
Laurel	Mingo
Little Beaver	Raleigh
New Creek Dam 14	Grant
Seneca	Pocahontas
Spruce Knob	Randolph
Summersville Reservoir	Nicholas
Summit	Greenbrier
Sutton Reservoir	Braxton
Teter Creek	Barbour
Tomlinson Run	Hancock
Thomas Park	Tucker
Trout Pond	Hardy
Warden	Hardy
Westover Park	Monongalia

The mining counties of West Virginia with the most extensive adverse potential impacts on trout due to surface coal mining are those in the east central part of the State. Pocahontas, Randolph, Webster, and Greenbrier Counties each have twelve or more individual water resources that are designated as Trout Waters. The major drainage basins in these counties include the Greenbrier, Gauley, Tygart, and Shavers Fork basins. The counties which have from six to eleven Trout Waters susceptible to adverse surface coal mining impacts include Upshur, Tucker, Nicholas, Preston, Fayette, and Grant.

Streams Polluted by Coalmine Wastes

Recent studies of the major river basins of West Virginia under Section 303(e) of the Federal Water Pollution Control Act (P.L. 92-500) have identified streams which are deemed to be "water quality limited" because of acid mine drainage. Water quality limited stream segments are not expected to attain West Virginia quality standards (Table 24) even after the best practicable control technology has been applied to point source industrial discharges and/or secondary treatment has been applied to municipal wastewater discharges. During the classification of stream segments, no distinction was made between polluted effluents from underground mines and those from surface mines, and discharge standards are uniform for both segments of the mining industry. A priority ranking for water quality limited streams affected by mine drainage was developed by WV-DNR on the basis of population, potential growth of mining activity, and known water quality problems. More than 2,850 miles of West Virginia streams are polluted by coal mine drainage (Table 25, Figure 21).

Table 24. West Virginia water quality standards[1] (WV-DNR 1974).

Parameter	Standard
Arsenic	0.01 mg/l
Barium	0.50 mg/l
Cadmium	0.01 mg/l
Chlorides	100. mg/l
Chromium (Hexavalent)	0.05 mg/l
Coliforms[2]	1000. organisms/100 ml
Cyanide	0.025 mg/l
Dissolved Oxygen[3]	5.0 mg/l
Fecal Coliforms[4]	200. organisms/100 ml
Fluorides	1.0 mg/l
Lead	0.05 mg/l
Nitrates	45. mg/l
pH[5]	6-8.5 pH units
Phenols	1.0 ppb
Selenium	0.01 mg/l
Silver	0.05 mg/l
Temperature[6]	73-87°F. (22.8-30.6°C)
Threshold Odor	No. 8 at 40°C
Toxic Substances	10% of 96 hour TLm

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[1] Applicable for all flows greater than or equal to the 7 consecutive days drought flow with a 10 year return frequency.

[2] Monthly average 1000/100 ml; Maximum daily 2400/100 ml.

[3] D.O. minimum of 6 mg/l in trout streams.

[4] 30 day geometric mean 200/100 ml; maximum daily for 10% of samples, 400/100 ml.

[5] Acid mine drainage streams: minimum pH 5.5.

[6] Trout waters: October-April 50°F.; September and May 58°F.; June-August 66°F. daily maximum. Other waters: 89°F. maximum May-November; 73°F. maximum December-April.

O H I O
P E N N S
K E N T U C K Y
MARSHALL
WETZEL
MONON
TYLER
PLEASANTS
WOOD
DODDRIDGE
HARRISON
TAYLOR
RITCHIE
BARBOUR
TUCKER
GRANT
WIRT
LEWIS
GILMER
UPSHUR
CALHOUN
JACKSON
RANDOLPH
MASON
ROANE
BRAXTON
PENDLETON
WEBSTER
CLAY
CABELL
CHARLESTON
KANAWHA
POCAHONTAS
WAYNE
LINCOLN
BOONE
FAYETTE
GREENBRIER
RALEIGH
LOGAN
WYOMING
SUMMERS
MONROE
MERCER
MC DOWELL
ST
SURFA
& STREAM
• ACTIV

A

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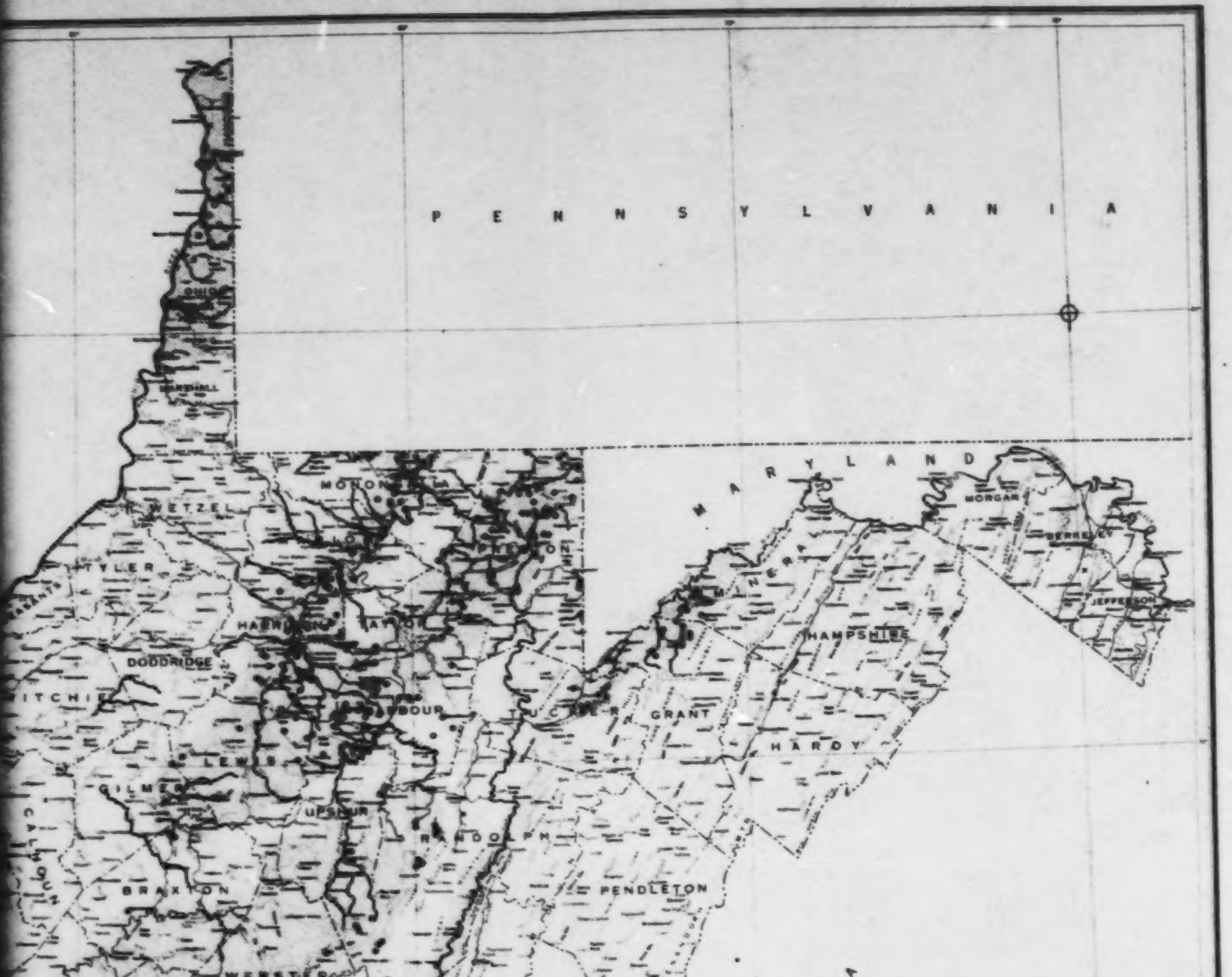
P E N N S Y L V A N I A
M A R Y L A N D
V I R G I N I A
WETZEL
MONONGALIA
MARSHALL
OHIO
TYLER
PRESTON
HARRISON
TAYLOR
DODDRIDGE
RITCHIE
BARBOUR
LEWIS
GILMER
CALHOUN
UPSHUR
RANDOLPH
BRAXTON
WEBSTER
CLAY
POCAHONTAS
FAYETTE
GREENBRIER
SUMMERS
MONROE
MERCER
MINERAL
TUCKER
GRANT
HARDY
PENDLETON
HAMPSHIRE
MORGAN
BERKELEY
JEFFERSON

STATE OF WEST VIRGINIA

SURFACE COAL MINING AREAS & STREAMS WITH ACID MINE DRAINAGE

• ACTIVE SURFACE MINE, 1976.

FIGURE 21

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B

Table 25. Water quality limited streams in West Virginia in which mine drainage is the prime source of pollution. Streams affected also by municipal (organic) pollutants are indicated with an asterisk. Streams in Priority Group E are not classified as water quality limited, but are known to have mine drainage problems. Dashes indicate that no data were listed by WV-DNR. Stream lengths generally are for named streams exclusive of tributaries, so they are minimum estimates (WV-DNR 1975b, 1976a, 1976b, 1976c, 1976d, 1976e).

River Basin	Priority Group	Stream	Segment Number	Stream Length (miles)
Ohio	A	Harmon Creek	102	23.5
	B	Wheeling, Little Wheeling, and Middle Wheeling Creeks	104	47.5
	B*	Short Creek	101	10.9
	C	Little Grave Creek	105	8.6
	C	Buffalo Creek	106	32.0
	C	Cross Creek	107	20.0
	D	Lick Creek	103	7.3
	D	Rich Creek	108	6.5
	E	Tenmile Creek	551	-
	E	Ice Creek	551	-
	E	Sliding Hill Creek	551	-
	E	Little Broad Run	551	-
				156.3
Monongahela	A*	Simpson Creek	608	29.1
	A*	Scotts Run	601	6.8
	A	Indian Creek	619	5.7
	A	Muddy Creek	636	13.2
	A	Three Forks River & Tribs.	630	31.6
	A	Rink Run	633	8.6
	B	Booths Creek	622	16.4
	B	Buffalo Creek	637	9.6
	B*	Browns Creek	610	4.5
	B	Sandy & Little Sandy Creeks	631	13.1
	B	Little Tenmile Creek	625	7.2
	B	Snowy Creek	640	-
	B*	Lost Creek	611	10.3
	C*	Limestone Run	609	6.5
	C	Bingamon Creek	623	14.2
	C	Isaac Creek	628	5.6

Table 25. Water quality limited streams in West Virginia in which mine drainage is the prime source of pollution (continued).

River Basin	Priority Group	Stream	Segment Number	Stream Length (miles)	
Monongahela (con't)	C	Big & Little Sandy Creeks	635	6.5	
	C	Pecks Run	632	8.4	
	C	Blackwater River (Upper)	638	12.8	
	C	Cheat River	614	38.0	
	C	Dunkard Mill	620	8.2	
	D	Elk Creek & Tribs.	627	22.4	
	D	Rhine Creek	639	4.8	
	D	Pyles Fork	621	14.2	
	D*	Deckers Creek	602	22.5	
	D	Rockcamp Creek	626	7.3	
	D	Middle Fork River	634	15.8	
	D*	Paw-Paw & Little Paw-Paw Creeks	603	13.8	
	D*	Tygart Valley River	612	156.0	
	D*	Buckhannon River & Tribs.	613	21.8	
	D*	West Fork River	605	74.3	
	D	Monongahela Mainstem	616	38.4	
	D	Dunkards Creek	617	14.4	
	D	Jones Creek	624	6.4	
	E	Dents Run	618	6.2	
	E	Skin Creek	629	10.5	
	E*	Buffalo Creek	604	16.2	
	E	Shavers Fork	615	85.0	
	E*	Helens Run	606	4.2	
	E*	Salem Fork	607	9.0	
					812.4
Little Kanawha	A	Copen Run	505	6.3	
	B	Cedar Creek	504	35.2	
	C	South Fork & Middle Fork, Hughes River	403	16.2	
	D	Sand Fork, Cove Lick, Indian Fork	502	107.6	
	E	Duck Run	551	-	
					282.1

Table 25. Water quality limited streams in West Virginia in which mine drainage is the prime source of pollution (continued).

River Basin	Priority Group	Stream	Segment Number	Stream Length (miles)
Kanawha	A*	Cabin Creek & Tribs.	408	21.4
	A*	Meadow River & Little Sewell Creek	412	52.5
	A	Gauley Mainstem	440	106.4
	B*	Spruce Fork	405	31.0
	B*	Piney Creek	417	33.5
	B	Peters Creek	442	17.0
	C*	Little Coal River	404	28.0
	C*	Clear Fork & Sycamore Creek	406	22.1
	C*	Campbells Creek	407	14.5
	C*	Paint Creek	410	28.0
	C*	Cherry River	413	28.0
	C*	Arbuckle Creek	415	3.3
	C	Marsh Fork	429	40.0
	D*	Pocatalico River	403	69.5
	D*	Kelly Creek	409	10.4
	D*	Smithers Creek	411	7.5
	D*	Dunloup Creek	416	15.6
	D	Big Coal River	424	39.8
	D	Pond Fork	426	45.5
	D	West Fork	427	16.5
	D	Spruce Laurel Fork	428	15.6
	D	Loop Creek	439	19.1
	D	Twenty Mile Creek	441	25.5
	E*	Marr Branch	414	2.0
	E	Logg Fork	423	4.9
	E	Peachtree Creek	430	6.2
	E	Sandlick Creek	431	9.2
	E	Blue Creek	434	21.5
	E	Birch River (MP 15-18) & Anthony Creek	435	8.8
	E	Elk River (MP 147.6-149), Bergoo & Leatherwood Creeks	436	14.1
	E	Hughes Creek	438	7.5
	E	Big & Little Clear Creeks	444	29.8
	E	Bluestone Mainstem	446	62.0
	E	Widemouth Creek	447	10.9

Table 25. Water quality limited streams in West Virginia in which mine drainage is the prime source of pollution (continued).

River Basin	Priority Group	Stream	Segment Number	Stream Length (miles)	
Kanawha (con't)	E	Widemouth Creek	447	10.9	
	F	Turtle Creek	425	7.3	
	F	Twomile Creek	432	9.5	
	F	Little Sandy & Wills Creeks	433	16.6	
	F	Witcher Creek	437	8.0	
	F	Anglins Creek	443	13.0	
	F	Pinch Creek	445	7.5	
	F	Slaughter Creek	448	6.8	
					936.0
Guyandotte	A*	Toney Fork	309	5.7	
	B*	Stonecoal Creek	314	9.1	
	B	Tommy Creek	318	6.1	
	B*	Slab Fork	312	14.6	
	B*	Barkers Creek	311	12.0	
	C*	Laurel Fork	308	22.6	
	C*	Clear Fork	307	28.2	
	C*	Island Creek	303	18.5	
	C*	Guyandotte Mainstem (MP 0-155)	301	155.0	
	C*	Huff Creek	306	19.6	
	D	Cub Creek	315	9.2	
	D	Pinnacle Creek	316	15.2	
	D	Cabin Creek	317	6.7	
	E*	Winding Gulf Creek	313	9.5	
	E*	Dingess Run	304	7.5	
	E*	Rum Creek	305	6.9	
	E*	Indian Creek	310	5.6	
	E	Rich Creek	351	-	
					352.0
Big Sandy-Tug Fork	A*	North Fork, Elkhorn Creek	209	7.6	
	A*	Elkhorn Creek	208	21.7	
	B*	Rock House Fork	202	9.9	
	B*	Pigeon Creek	201	24.9	
	B	Beech Creek	211	6.8	

Table 25. Water quality limited streams in West Virginia in which mine drainage is the prime source of pollution (concluded).

River Basin	Priority Group	Stream	Segment Number	Stream Length (miles)	
Big Sandy-Tug Fork (con't)	B	Left Fork	212	4.2	
	B*	Mate Creek	203	10.5	
	C*	Jacobs Fork	207	12.3	
	C*	Dry Fork	204	40.4	
	C	Long Branch	215	5.4	
	C	Big Sandy-Tug Fork	210	82.0	
	D	Meathouse Fork	214	3.8	
	D	Panther Creek	213	7.9	
	E	Bradshaw Creek	205	5.2	
	E	Barrenshe Creek	206	3.9	
	E	War Creek	251	-	
	E	Clear Fork	251	-	
	E	Spice Creek	251	-	
	E	Browns Creek	251	-	
	E	Trace Fork, Panther Creek	251	-	
					254.2
Potomac	A	Buffalo Creek	751	-	
	A	Abrams Run, Emory Creek, Glade Run	703	25.0	
	A	Stony River	706	25.7	
	A	Piney Swamp Run	751	-	
	B	Deakin-Elk Run	751	-	
	C	Lynwood Run	751	-	
	C	Montgomery Run	751	-	
	C	Slaughterhouse Run	751	-	
	C	Dobbin Ridge Run	751	-	
	D	Difficult Creek	705	5.1	
	D	Red Oak Run	751	-	
	D	Deep Run	751	-	
	D	Powderhouse Run	751	-	
					55.8
					2,848.8

Lakes and Reservoirs

Except for the water that is (1) ponded in a few high-elevation glades, (2) stored in naturally plugged sinkholes in the eastern part of the State, or (3) present in stream channels and floodplains during peak flow periods, surface water storage in West Virginia is restricted to artificial impoundments. Artificial lakes in the State range in size from privately constructed farm ponds (usually less than one acre in extent) to major reservoirs that occupy more than 1,000 acres.

Surface mining potentially can affect lakes adversely in several ways. Sediment that is eroded from a surface mined site or from access roads can alter channel configurations, can increase turbidity of the receiving waters and thereby decrease photosynthetic rates, and can clog respiratory organs or other organs of zooplankton, larger invertebrates, and fishes in a lake. Because lakes are quiet bodies of water, sediments can settle so rapidly that much of the benthic habitat and biota are destroyed, at least temporarily. Continued rapid sedimentation and filling can decrease the life expectancy of a lake, reduce its storage effectiveness for flood control or low-flow augmentation, and reduce its aesthetic quality for fishing, swimming, or other recreational activities. Sedimentation is a particularly important problem in the coalfields of southern West Virginia, where there are many steep slopes.

Surface mining of coal traditionally has reduced the chemical quality of the receiving waters by the addition of significant quantities of acid and metals, particularly iron, to the dissolved constituents of the receiving waters. The overburden rock in many parts of northern West Virginia contains much acid-producing material, and the high-sulfur coals also can produce acid drainage. Because the buffering capacity of the surface waters in West Virginia generally is low, small amounts of acid drainage from surface mining operations can lower the pH of surface water significantly, but the drainage from underground mines generally is considered an even more severe problem. A rapid change in pH can affect aquatic biota adversely. If pH shifts are great enough, they can cause fish kills. Various metals are more toxic to aquatic biota under acid than under neutral conditions.

Lakes contain large quantities of water which may dilute sudden discharges of acid from a surface mining operation, but the residence time of acid waters may be lengthy. Therefore, the adverse impacts of diluted acid wastes on the aquatic biota may be equally severe as those caused by short exposures to undiluted discharges.

Federal Installations

Of the eight lakes owned and operated by the US government in West Virginia (Figure 22, Table 26), five are situated in counties where surface mining of coal occurs at the present time. Bluestone Lake, although located in Summers County, is downslope and within the drainage basin of part of Raleigh County where operating surface mines are located. Beech Fork Lake and East Lynn Lake, both in Wayne County, are downstream from areas that potentially could be surface mined. Together, the Federal land which surrounds the eight potentially affected Federal lakes encompasses 94,280 acres (WV-DNR 1972).

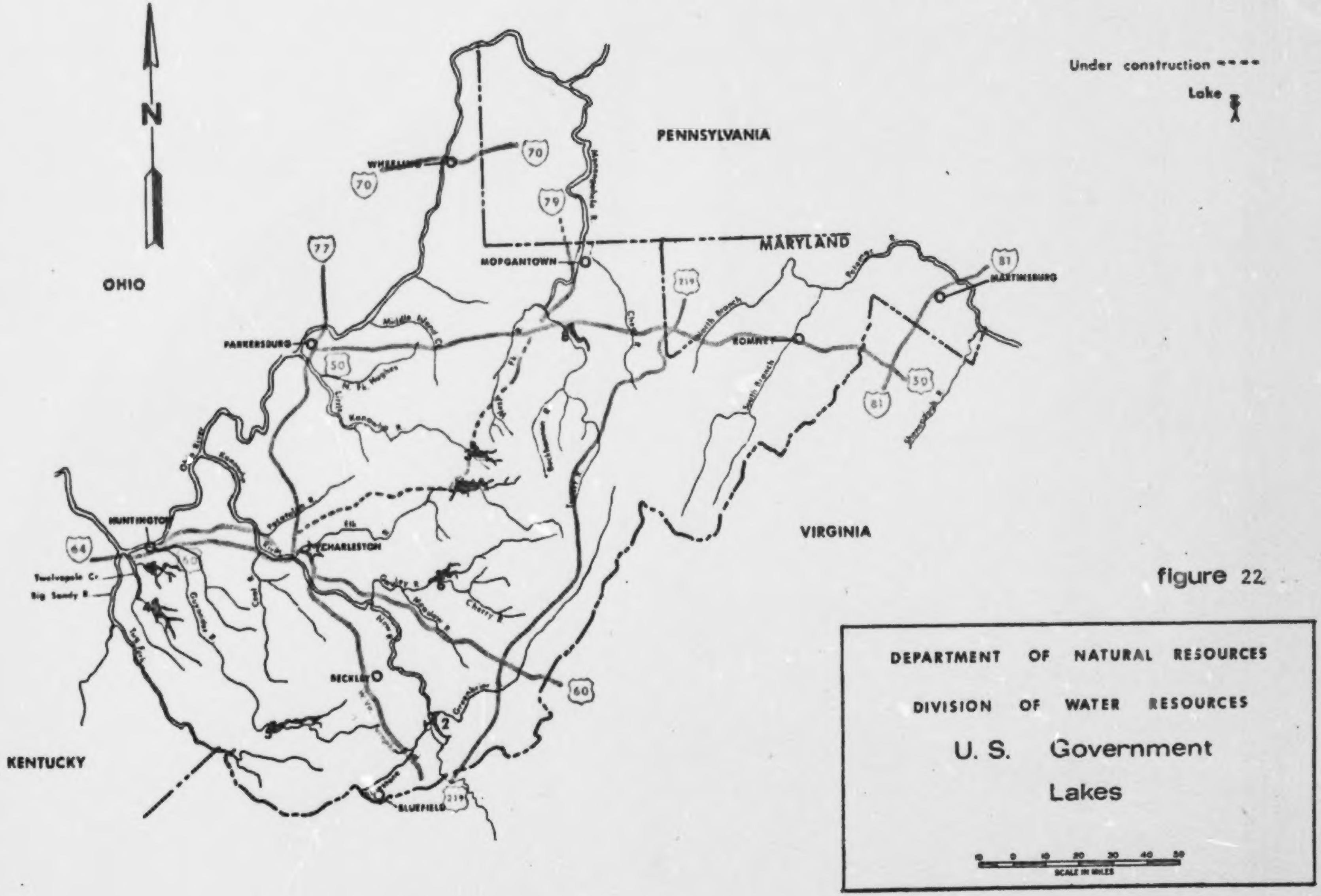
Four of the hydroelectric dams (Figure 23 , Table 27) and 7 of the navigational locks and dams (Figure 24 , Table 28) are located in counties that produce coal from surface mines. These reservoirs are particularly sensitive to the effects of sedimentation, because minimum depths must be maintained by dredging. Sufficient depth is required not only for navigation between successive dams and locks but also for the optimal generation of hydroelectric power.

State Lakes

The West Virginia Department of Natural Resources maintains 48 lakes that are utilized for recreation, for enhancement of fish and wildlife habitats, and for flood control (Figure 25, Table 29). Of these, 27 are located in counties that produce coal from surface mines. Adverse impacts to these lakes probably would be to the aquatic biota and to the aesthetic quality of the lakes, whose recreational value consequently would decline.

Municipal and Other Lakes

Thirty six lakes are municipally owned or owned by water supply companies in West Virginia (Figure 26, Table 30). Of these, 25 are located in counties that currently produce coal from surface mines. Because groundwater, except along the Ohio River, is an unreliable source of large quantities of water, surface reservoirs are necessary to supply water to large communities in West Virginia. Acid sediment or discharges from surface mines can degrade water quality significantly and thereby increase the cost of treatment prior to consumption.


Under construction
Lake
N
OHIO
PENNSYLVANIA
MARYLAND
VIRGINIA
KENTUCKY
WHEELING
MORGANTOWN
PARKERSBURG
ROMNEY
MARTINSBURG
HUNTINGTON
CHARLESTON
BECKLEY
BLUEFIELD
70
79
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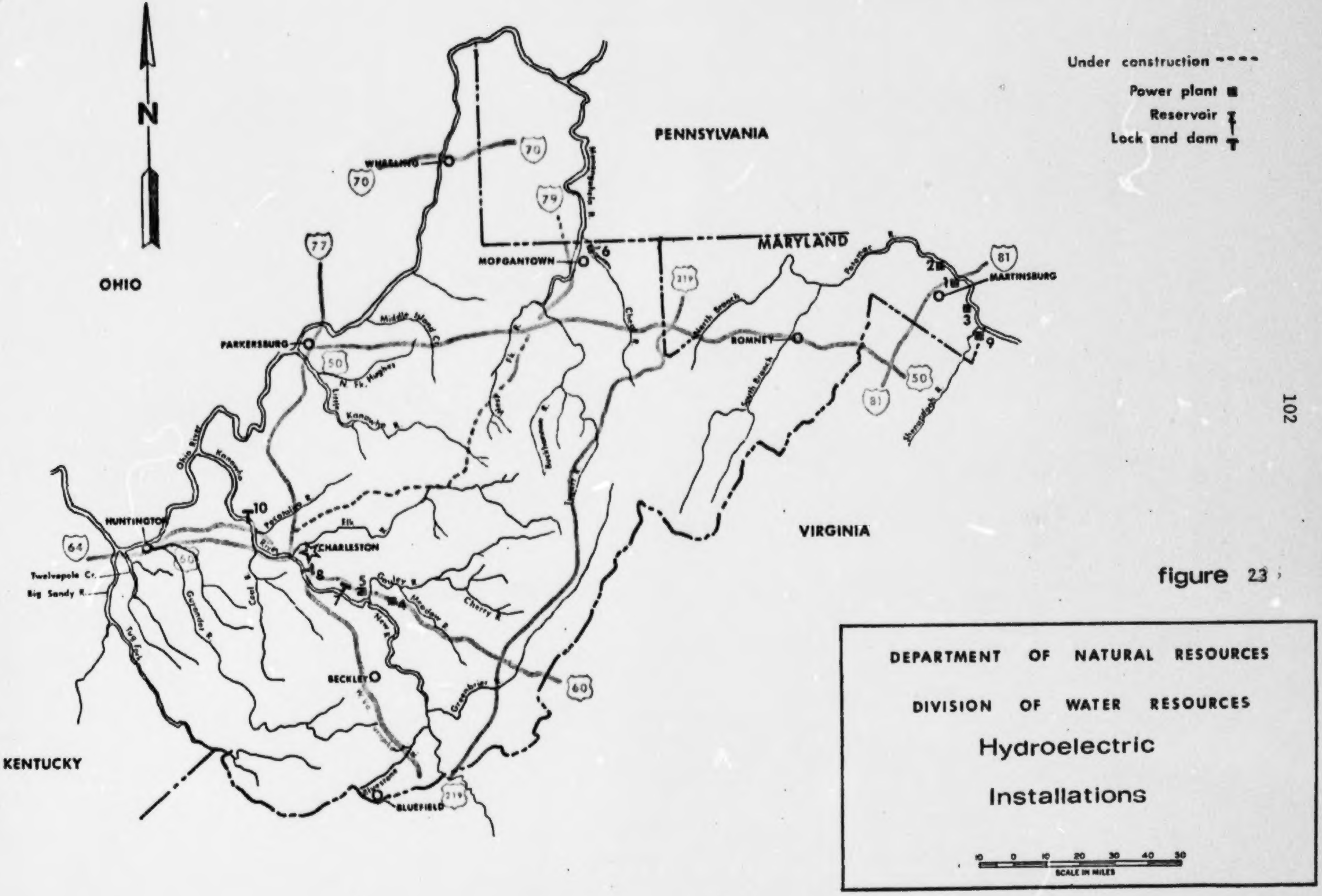
60
2
Monongahela R.
Cheat R.
North Branch
South Branch
Potomac R.
Shenandoah R.
Middle Island Cr.
N. Fk. Hughes
Little Kanawha R.
Buckhannon R.
Elk R.
Coal R.
Kanawha R.
Gauley R.
Meadow R.
Cherry R.
New R.
Greenbrier
Guyandot R.
Twelvepole Cr.
Big Sandy R.
Tug Fork
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WATER RESOURCES
U. S. Government
Lakes
0
10
20
30
40
50
SCALE IN MILES

figure 22

Table 26. Lakes administered by the Army Corps of Engineers in West Virginia (WV-DNR 1972). Uses are F, sport fishing; F & W, fish and wildlife; WQ, water quality maintenance during low-flow periods; Rec., recreation; N, navigation. Asterisks (*) denote lakes near current surface mining areas.

	Name	Stream	D.A. (sq. mi.)	Date Comp.	Max. Cap. A.F.	Use	Height of Dam	Federal Land Acreage	County
1.	Beech Fork	Beech Fork	78	1974	380,000	F, F & W, Rec.	86'	8,373	Wayne
2.	Bluestone*	New River	4,602	1949	631,000	F	165'	23,930	Summers
3.	Burnsville*	Little Kanawha	165	Initiated	65,000	F, F & W, WQ, Rec.	80'	7,060	Braxton
4.	East Lynn	East Fork (Twelvepole Cr.)	133	1971	82,500	F, F & W, Rec.	122'	24,365	Wayne
5.	R. D. Bailey*	Guyandotte R.	540	U.C.	204,000	F, F & W, WQ, Rec.	310'	5,050	Wyoming
6.	Summersville*	Gauley River	803	1968	413,800	F, WQ	350'	9,346	Nicholas
7.	Sutton*	Elk River	537	1961	265,300	F, WQ	210'	13,473	Braxton
8.	Tygart*	Tygart Valley River	1,184	1938	286,600	F, N	230'	2,683	Taylor


N
OHIO
PENNSYLVANIA
MARYLAND
VIRGINIA
KENTUCKY
Under construction
Power plant
Reservoir
Lock and dam
WHEELING
MORGANTOWN
PARKERSBURG
ROMNEY
MARTINSBURG
HUNTINGTON
CHARLESTON
BECKLEY
BLUEFIELD
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219
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64
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Monongahela R.
Cheat R.
Potomac R.
North Branch
South Branch
Shenandoah R.
Middle Island Cr.
N. Fk. Hughes
Little Kanawha R.
Ohio River
Kanawha River
Elk R.
Coal R.
Guyandot R.
Twelvepole Cr.
Big Sandy R.
Tug Fork
Gauley R.
Meadow R.
Cherry R.
New R.
Greenbrier
Bluestone
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SCALE IN MILES

DEPARTMENT OF NATURAL RESOURCES

DIVISION OF WATER RESOURCES

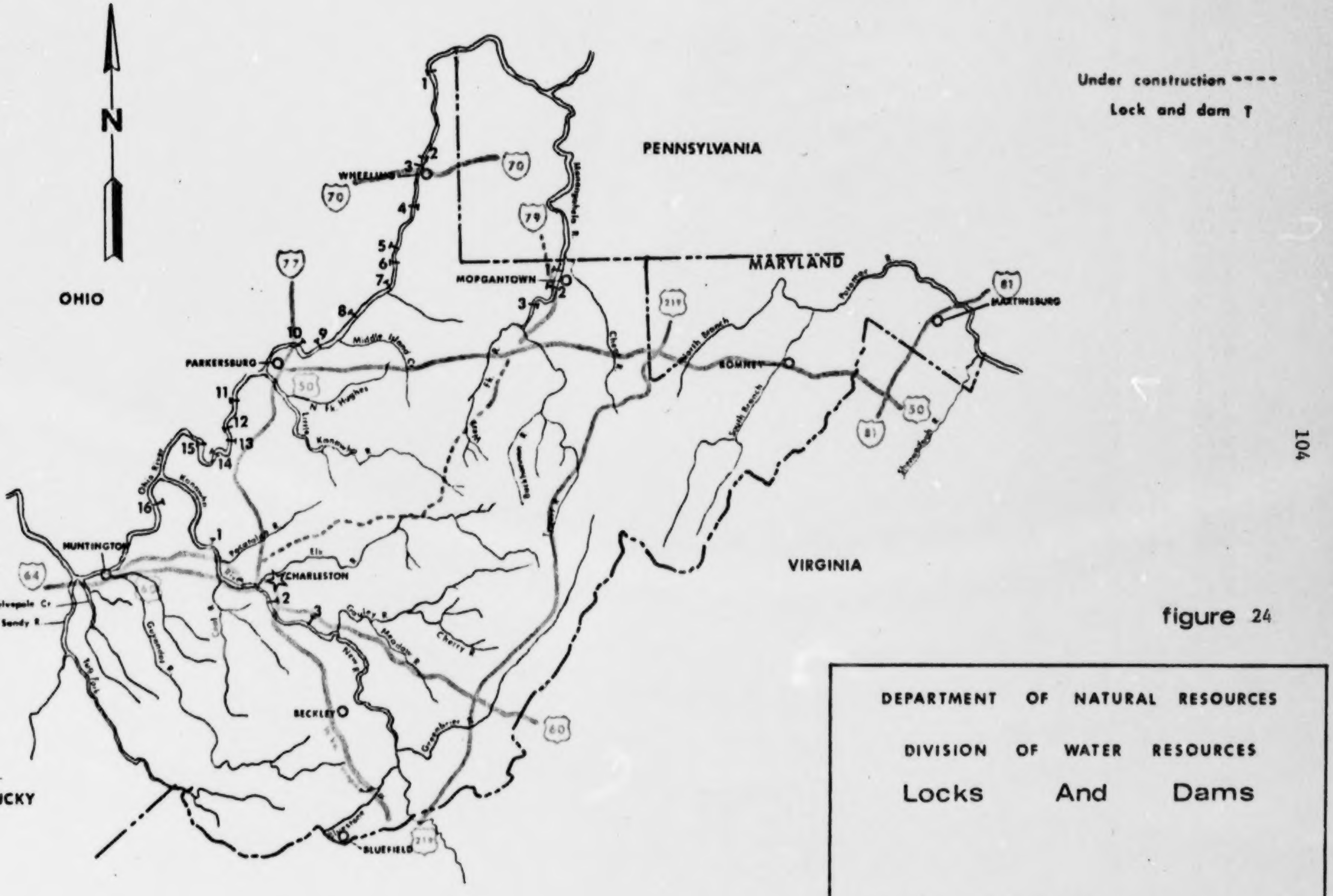
Hydroelectric

Installations

figure 23

Table 27. Hydroelectric installations in West Virginia (WV-DNR 1972). Entries with an asterisk (*) are potentially affected by surface mining operations in their watersheds.

	Name	Stream	D.A. (sq. mi.)	Date Comp.	Use	Height of Dam	Owner	County
1.	Dam #4	Potomac River	5,700	1909	P	20'	Potomac Edison of W.Va.	Jefferson
2.	Dam #5	Potomac River	5,100	1919	P	20'	Potomac Edison of W.Va.	Jefferson
3.	Harpers Ferry	Potomac River	6,200	1925	P	18'	Potomac Edison of Virginia	Jefferson
4.	Hawks Nest*	New River	6,856	1937	P	60'	Union Carbide	Fayette
5.	Kanawha Falls* (Glen Ferris)	Kanawha River	8,300	1901	P	56'	Union Carbide	Fayette
6.	Lake Lynn *	Cheat River	1,413	1926	P	100'	West Penn. Power Co.	Monongalia
7.	London L & D *	Kanawha River	8,492	1934	P, N	50'	Kan. Valley Power Co.	Kanawha
8.	Marmet L & D*	Kanawha River	8,818	1934	P, N	60'	Kan. Valley Power Co.	Kanawha
9.	Millville	Shenandoah River	3,040	1939	P	26'	Potomac Edison of W.Va.	Jefferson
10.	Winfield L & D	Kanawha River	11,810	1937	P, N	61'	Kan. Valley Power Co.	Putnam


N
OHIO
PENNSYLVANIA
MARYLAND
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WHEELING
MORGANTOWN
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HUNTINGTON
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BLUEFIELD
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Monongahela R.
Cheat R.
Middle Island Cr.
N. Fk. Hughes
Little Kanawha R.
Ohio River
Kanawha
Pocatalico R.
Elk R.
Coal R.
Guyandot R.
Twelvepole Cr.
Big Sandy R.
Tug Fork
Gauley R.
Meadow R.
Cherry R.
New R.
Greenbrier R.
North Branch
South Branch
Potomac R.
Shenandoah R.
Buckhannon R.
West Fk. R.
Tygart R.
Bluestone R.
10 0 10 20 30 40 50
SCALE IN MILES

Under construction ----
Lock and dam T

figure 24

DEPARTMENT OF NATURAL RESOURCES

DIVISION OF WATER RESOURCES

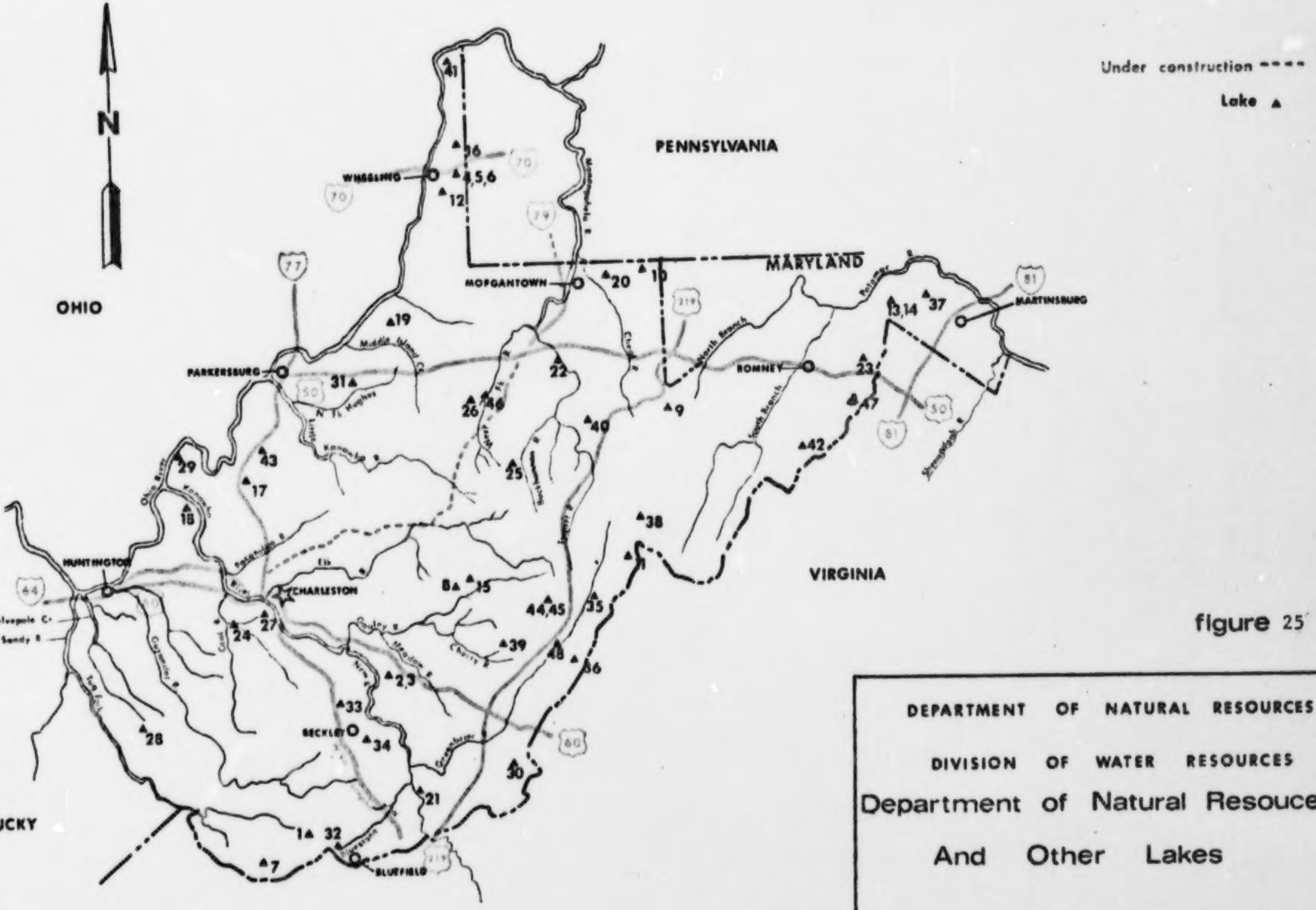
Locks And Dams

Table 28. Locks and dams in West Virginia (WV-DNR 1972). Entries marked with an asterisk (*) potentially are affected by surface coal mining in their watersheds. R indicated facilities scheduled to be replaced. N denotes use for navigation; P, use for power generation.

Name	Stream	D.A. (sq. mi.)	Date Comp.	Use	Height of Dam	Owner	County
OHIO RIVER							
1. New Cumberland *	Ohio River	23,870	1961	N	28'	U. S. Govt.	Hancock
2. Pike Island	Ohio River	24,400	1965	N	35'	U. S. Govt.	Ohio
3. L & D #12 (R)	Ohio River	24,661	1917	N	18'	U. S. Govt.	Ohio
4. L & D #13 (R)	Ohio River	25,183	1911	N	17'	U. S. Govt.	Marshall
5. L & D #14 (R)	Ohio River	25,750	1917	N	18'	U. S. Govt.	Wetzel
6. Hannibal	Ohio River	25,960	U.C.	N	38'	U. S. Govt.	Wetzel
7. L & D #15 (R)	Ohio River	26,190	1916	N	18'	U. S. Govt.	Tyler
8. L & D #16 (R)	Ohio River	26,270	1917	N	18'	U. S. Govt.	Pleasants
9. Willow Island	Ohio River	26,900	U.C.	N	30'	U. S. Govt.	Pleasants
10. L & D #17 (R)	Ohio River	--	--	N	18'	U. S. Govt.	Wood
11. Belleville	Ohio River	39,350	1969	N	35'	U. S. Govt.	Mason
12. L & D #21 (R)	Ohio River	39,680	1919	N	18'	U. S. Govt.	Wood
13. L & D #22 (R)	Ohio River	39,843	1918	N	17'	U. S. Govt.	Jackson
14. L & D #23 (R)	Ohio River	40,090	1921	N	15'	U. S. Govt.	Jackson/Masor

Table 28. Locks and dams (concluded).

Name	Stream	D.A. (sq. mi.)	Date Comp.	Use	Height of Dam	Owner	County
15. Racine	Ohio River	40,130	U.C.	N	37'	U. S. Govt.	Mason
16. Gallipolis	Ohio River	--	1937	N	35'	U. S. Govt.	Mason
KANAWHA RIVER							
1. Winfield	Kanawha River	11,810	1937	P, N	61'	Kan. Valley Power Co. & U. S. Govt.	Putnam
2. Marmet *	Kanawha River	8,818	1934	P, N	60'	Kan. Valley Power Co. & U. S. Govt.	Kanawha
3. London *	Kanawha River	8,492	1934	P, N	50'	Kan. Valley Power Co. & U. S. Govt.	Kanawha
MONONGAHELA RIVER							
1. Opekiska*	Monongahela River	2,530	1968	N	37'	U. S. Govt.	Marion
2. Morgantown *	Monongahela River	2,584	1950	N	27'	U. S. Govt.	Monongalia
3. Hildebrande*	Monongahela River	2,544	1959	N	34'	U. S. Govt.	Monongalia/ Marion


Under construction
Lake ▲
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PENNSYLVANIA
MARYLAND
VIRGINIA
KENTUCKY
WHEELING
MORGANTOWN
PARKERSBURG
ROMNEY
MARTINSBURG
HUNTINGTON
CHARLESTON
BECKLEY
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Monongahela R.
Cheat R.
Potomac R.
North Branch
South Branch
Shenandoah R.
Middle Island Cr.
N. Fk. Hughes
Little Kanawha R.
Ohio River
Kanawha
Elk
Pocatalico R.
Coal
Gauley R.
Meadow R.
Cherry R.
New R.
Greenbrier R.
Guyandot R.
Tug Fork
Twelvepole Cr.
Big Sandy R.
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SCALE IN MILES

figure 25

DEPARTMENT OF NATURAL RESOURCES

DIVISION OF WATER RESOURCES

Department of Natural Resouces

And Other Lakes

Table 29. Department of Natural Resources and other lakes in West Virginia (WV-DNR 1972). Entries marked with an asterisk (*) are situated in surface coal mining counties. Abbreviated use designations are Rec., recreation; F, fishing; and W, wildlife.

	Name	Stream	D.A. (Acres)	Date Comp.	Reservoir Capacity (A.F.)	Use	Height of Dam	Owner	County
1.	Anawalt *	Tug Fork	1,100	1964	6	Rec.	19'	State	McDowell
2.	Babcock State * Park Lake	Glade Creek	--	--	2	Rec.	--	State	Fayette
3.	Babcock State * Park Lake	Glade Creek	290	1965	18	Rec.	30'	State	Fayette
4.	Bear Rock Dam #1	Todd Run	640	1954	3.4	Rec.	21'	State	Ohio
5.	Bear Rock Dam #2	Todd Run	640	--	8.0	Rec.	31'	State	Ohio
6.	Bear Rock Dam #3	Todd Run	640	--	3.2	Rec.	17'	State	Ohio
7.	Berwind Lake *	Big Branch of War Creek	3,138	1958	20	Rec.	32'	State	McDowell
8.	Big Ditch Run #1 *	Big Ditch Run (trib. of Gauley)	--	1968	595	Rec.	23'	State	Webster
9.	Blackwater Falls * Reservoir	Pendleton Creek (Blackwater R.)	3,600	1957	160	Rec.	28'	State	Tucker
10.	Bruceton Mills *	Big Sandy Creek	--	--	20	Rec.	8'	State	Preston
11.	Buffalo Fork *	Little River	3,140	1969	21.5	Rec., F	43'	State	Pocahontas
12.	Burches Run Lake*	Burch Run of Wheeling Creek	3,436	1962	--	Rec.	35'	State	Marshall
13.	Cacapon Lake	Indian Run of Sleepy Creek	--	1937	6	Rec.	30'	State	Morgan

Table 29. WV-DNR lakes (continued).

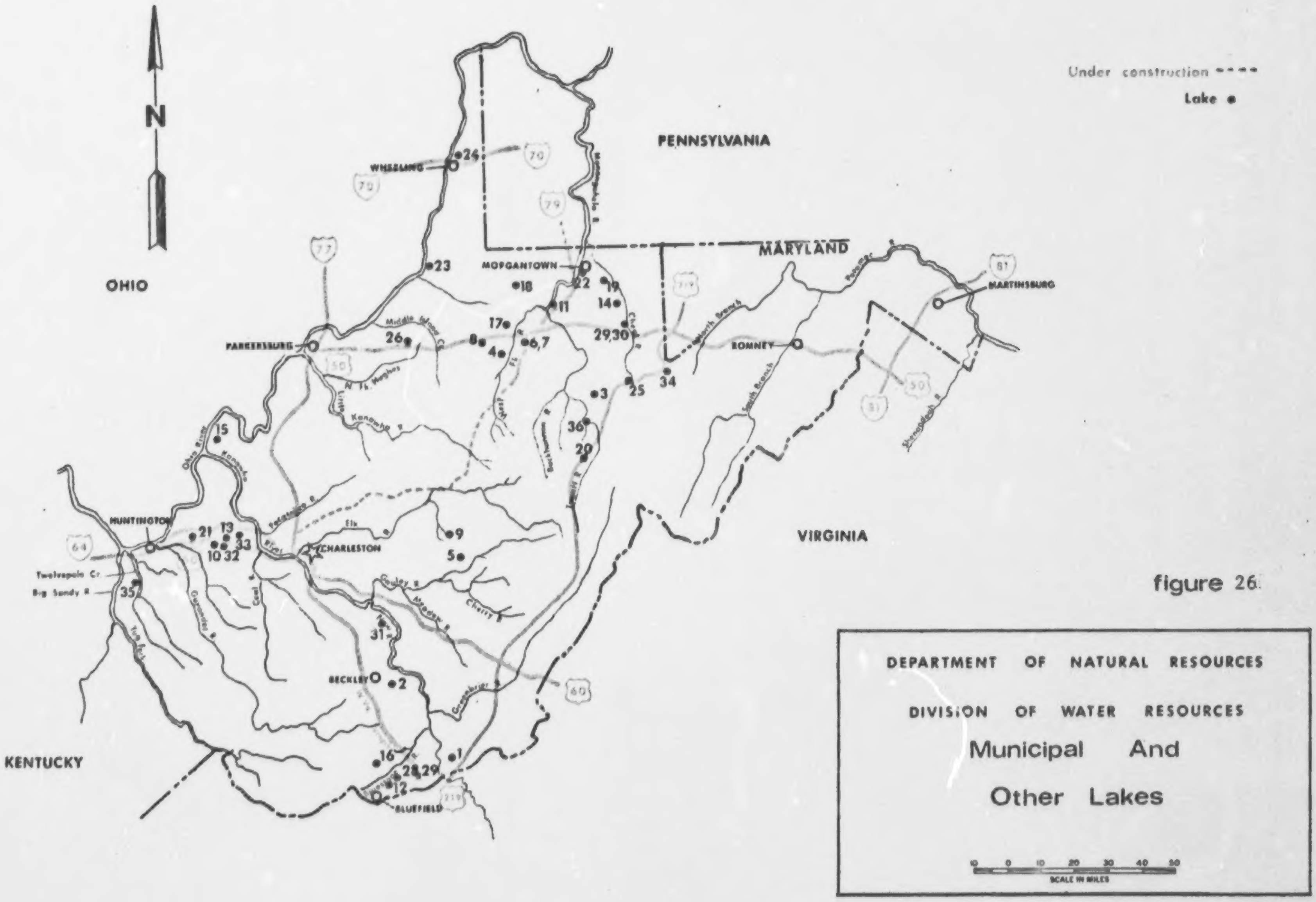
	Name	Stream	D.A. (Acres)	Date Comp.	Reservoir Capacity (A.F.)	Use	Height of Dam	Owner	County
14.	Cacapon State Park Lake	Indian Run of Sleepy Creek	3,200	--	61	Rec.	25'	State	Morgan
15.	Camp Caesar Lake *	Upper Glade Run of Gauley River	796	--	34.2	Rec.	17'	4-H	Webster
16.	Castlemans Run * Lake	Castlemans Run	5,500	1961	--	Rec., F	31'	State	Brooke/Ohio
17.	Cedar Lake	Mill Creek	--	1954	10	F & W	30'	FFA-FHA	Jackson
18.	Chief Cornstalk	Kanawha River	260	1964	5	Rec.	15'	State	Mason
19.	Conaway Lake	Conaway Run	922	1963	35	Rec.	40'	State	Tyler
20.	Coopers Rock * Lake	Glade Run (Cheat River)	700	1954	--	Rec.	23'	State	Monongalia
21.	Crumps Bottom (Sub-impoundment)		--	--	3	Rec.	10'	State	Summers
22.	Doe Run (Sub- * impoundment)		--	1961	12	Rec.	17'	State	Taylor
23.	Edwards Run Pond	Edwards Run	--	1960	2	Rec.	10'	State	Hampshire
24.	Fork Creek *	Fork Creek	--	1965	1.06	Rec.	15'	State	Boone
25.	French Creek * Game Farm Lake	Flatwood Run	--	--	2	Rec.	--	State	Upshur

Table 29. WV-DNR lakes (continued).

	Name	Stream	D.A. (Acres)	Date Comp.	Reservoir Capacity (A.F.)	Use	Height of Dam	Owner	County
26.	Jackson's Mill * Lake	Quarry Run	76	--	1.6	Rec., I	28'	4-H	Lewis
27.	Kanawha State * Forest	Davis Creek	--	1938	1	Rec.	--	State	Kanawha
28.	Laurel Creek * Lake #1	Twelvepole Cr.	6,830	1961	--	Rec.	43'	State	Mingo
29.	McClintic Wildlife Area (40 ponds)	Oldtown Creek	--	--	--	Rec. Water Fowl	--	State	Mason
30.	Moncove Lake	Devil Creek (Second Cr.)	2,284	1959	144	Rec.	30'	State	Monroe
31.	North Bend Lake	North Fork (Hughes R.)	38	--	5	Rec.	--	State	Ritchie
32.	Pinnacle Rock *	Lick Branch	1,060	1966	14.7	Rec.	32'	State	Mercer
33.	Plum Orchard Lk.*	Plum Orchard Creek of Paint Creek	2,655	1962	--	Rec.	50'	State	Fayette
34.	Raleigh Co. 4-H * Camp	Little Beaver Cr.	7,000	--	18	Rec.	--	Raleigh Co. 4-H	Raleigh
35.	Seneca Lake	Little Thorny Cr.	--	1952	3	Rec.	14'	State	Pocahontas

Table 29. WV-DNR lakes (concluded).

	Name	Stream	D.A. (Acres)	Date Comp.	Reservoir Capacity (A.F.)	Use	Height of Dam	Owner	County
36.	Sherwood Lake *	Meadow Creek	4,020	1958	164	Rec.	21'	State	Greenbrier
37.	Sleepy Cr. Lake	Meadow Branch	5,375	1962	--	Rec.	36'	State	Berkeley
38.	Spruce Knob Lk. *	Narrow Ridge Run of Gandy Creek	303	--	23	Rec.	27'	State	Randolph
39.	Summit Lake *	North Fork of Cherry River	640	1956	43	Rec.	25'	State	Greenbrier
40.	Teter Creek Lk.*	Teter Creek (Tygart River)	1,632	1958	--	Rec.	30'	State	Barbour
41.	Tomlinson Run * State Park Lk.	Tomlinson Run	13,824	1942	30	Rec.	43'	State	Hancock
42.	Trout Pond	Trout Run of Cacapon River	--	--	--	Rec., F.	--	State	Hardy
43.	Turkey Run Lk.	Turkey Run	1,660	1964	15	F	--	State	Jackson
44.	W. W. Warner Pond #1	Laurel Creek (Williams River)	--	1946	--	Rec., F & W	12.5'	State	Pocahontas
45.	W. W. Warner Pond #2	Laurel Creek	--	1949	--	Rec.	12.0'	State	Pocahontas
46.	Watters Smith * State Park	Duck Creek	--	--	--	Rec.	--	State	Harrison
47.	Warden Lake	Moores Run	6,528	1959	36	Rec.	31'	State	Hardy
48.	Watoga Lake	Island Lick Run	1,402	1936	11	Rec.	45'	State	Pocahontas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MORGANTOWN
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ROMNEY
MARTINSBURG
HUNTINGTON
CHARLESTON
BECKLEY
BLUEFIELD
Twelvepole Cr.
Big Sandy R.
70
79
77
50
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219
Middle Island Cr.
Little Kanawha R.
Ohio River
Kanawha
Elk R.
Gauley R.
Meadow R.
Cherry R.
Greenbrier
Coal R.
Guyandot R.
Tug Fork
New R.
Cheat R.
North Branch
South Branch
Potomac R.
Shenandoah R.
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Buckhannon R.
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SCALE IN MILES

figure 26

DEPARTMENT OF NATURAL RESOURCES

DIVISION OF WATER RESOURCES

Municipal And Other Lakes

Table 30. Municipal and other lakes in West Virginia (WV-DNR 1972). Lakes in coal mining counties are indicated by an asterisk (*). Abbreviated use designations are WS, water supply; F&W, fish and wildlife; and Rec., recreation.

Name	Stream	D.A. (Acres)	Date Comp.	Reservoir Capacity (A.F.)	Use	Height of Dam	Owner	County
1. Ballard	New River	--	1968	--	WS	--	Ballard Water Works Assoc.	Monroe
2. Beckley Water * Company	Glade Creek (New River)	16,000	1941	1,227.6	WS	33'	Beckley Water Company	Raleigh
3. Belington *	Tygart Valley River	576	--	--	WS	21'	City of Belington	Barbour
4. Buffalo Lake *	Buffalo Creek of West Fork	3,520	1956	920.7	WS	47.5'	Clarksburg Water Board	Harrison
5. Camden-on-Gauley *	Gauley	--	1965	--	WS	--	Camden-on-Gauley	Webster
6. City of Bridge- * port (Deegan Lake)	Davisson Run	1,200	1954	--	WS, F & W, Boating	30'	City of Bridgeport	Harrison
7. City of Bridge- * port (Hinkle Lake)	Davisson Run	800	1954	--		20'	City of Bridgeport	Harrison
8. City of Salem *	Dog Run	675	1970	153	WS	42'	City of Salem	Harrison
9. Cowen *	Birch River (Elk)	--	--	--	WS	--	Cowen PSD	Webster
10. Culloden Water Reservoir	Ball Creek	1,600	1960	13	WS	20'	Culloden PSD	Cabell

Table 30. Municipal and other lakes (continued).

Name	Stream	D.A. (Acres)	Date Comp.	Reservoir Capacity (A.F.)	Use	Height of Dam	Owner	County
11. Fairmont * Filtration Plant	Tygart Valley River	--	1938	289,550	Filtration plant for water	217'	City of Fairmont	Marion
12. Green Valley * Glenwood	Brush Creek	592	1965	--	WS	36'	Green Valley Glenwood PSD	Mercer
13. Hurricane Water Reservoir	Mill Creek of Hurricane Creek	75	1967	60	WS	8'	City of Hurricane	Putnam
14. Kingwood *	Ashpole Run	500	1930	--	WS	22'	Town of Kindwood	Preston
15. Krodel Lake	Kanawha	10	1948	4	Rec.	--	City of Pt. Pleasant	Mason
16. Lashmeet *	Pocosion Fork of Rich Creek	--	1970	11	WS	14'	Lashmeet PSD	Mercer
17. Lumberport * Lake	West Fork River	248	1928	3	WS	10'	Town of Lumberport	Harrison
18. Mannington * Lake	Little Dents Run	572	1969	245.5	WS	54'	Town of Mannington	Marion
19. Masontown * Lake	Back Run of Decker's Creek	1,450	1956	21.5	WS	30'	Town of Masontown	Preston
20. Mill Creek *	Mill Creek (Tygart)	160	1968	--	WS	4'	Mill Creek	Randolph

Table 30. Municipal and other lakes (continued).

Name	Stream	D.A. (Acres)	Date Comp.	Reservoir Capacity (A.F.)	Use	Height of Dam	Owner	County
21. Milton Water Reservoir	Mud River	--	1962	--	WS	8'	Town of Milton	Cabell
22. Morgantown Lake *	Cobun Creek	4,800	1958	192.8	WS	49'	City of Morgantown	Monongal
23. New Martinsville	Ohio	--	--	--	Rec.	--	City of Martinsville	Wetzel
24. Oglebay City Park	Waddles Run	100	1953	36	Rec.	24'	City of Wheeling	Ohio
25. Parsons Lake *	Elk Lick Run (Cheat River)	1,575	1934	15.4	WS	24'	Town of Parsons	Tucker
26. Pennsboro	No. Fork Hughes River	--	--	--	WS	--	Town of Pennsboro	Ritchie
27. Princeton*	Brush Creek	4,956	--	1,469	F & Rec.	36.3'	City of Princeton	Mercer
28. Princeton*	Brush Creek	1,766	1967	2,092.5	WS	74'	City of Princeton	Mercer
29. Rowlesburg *	Cheat River	500	1929	4.0	WS	15'	Town of Rowlesburg	Preston
30. Rowlesburg*	Cheat River	500	1934	4.0	WS	18'	Town of Rowlesburg	Preston
31. Salem-Gatewood* Cunard-Brooklyn	New River	384	--	1,150	WS	--	Salem-Gatewood PSD	Fayette

Table 30. Municipal and other lakes (concluded).

	Name	Stream	D.A. (Acres)	Date Comp.	Reservoir Capacity (A.F.)	Use	Height of Dam	Owner	County
32.	Sunnybrook	Kanawha	--	--	--	WS	--	Sunnybrook Water Assoc.	Putnam
33.	Teays Valley Public Service District	Poplar Fork Creek	100	1964	37	WS	10'	Teays Valley PSD	Putnam
34.	Thomas Lake *	No. Fork of Blackwater River	850	--	39.9	WS	25'	Town of Thomas	Tucker
35.	Wayne Water Reservoir	Twelvepole Creek	--	--	0.23	WS	6'	Town of Wayne	Wayne
36.	Womelsdorff *	Roaring Creek (Tygart)	2	--	--	WS	22'	Womelsdorff	Randolph

In addition to these lakes, there are 56 private lakes which are used for recreation, individual industrial water supplies, cooling water, fish and wildlife management, and power generation; 119 soil conservation service lakes which were built primarily to give local flood protection in small stream basins and the headwaters of the larger streams; and 363 farm ponds 1 acre or larger which were built to provide water for livestock, for recreational purposes, for fish production, and for supplementary occasional water supplies, in the State as a whole (WV-DNR 1972).

Public Water Supplies

Of the 806 public water purveyors in West Virginia, 458 systems pump groundwater and 209 systems utilize surface water for municipal water supplies. Another 139 systems purchase water from a supplier (Verbally, Mr. James Hodges, West Virginia Department of Health, Charleston, 15 December 1976). Thus, about 69% of the systems that produce their own water for municipal consumption use groundwater from wells.

Municipal water supplies for large communities, except those situated on the Ohio River and for the City of Martinsburg, are derived from surface reservoirs (Table 31). About 36 surface reservoirs have been constructed in West Virginia for water supply to serve these larger communities (Figure 26). Storage reservoirs are necessary because streamflow may decline to low levels during periods with little precipitation. In 1960 about 64% of the population was served by public water systems from surface water supplies (Doll et al. 1963). More recent data were not available, but it is probable that no significant change has occurred in the proportion of the population supplied from surface supplies. Wells that penetrate bedrock in West Virginia generally do not produce great enough quantities of water to supply large populations.

Groundwater Resources

With the exception of Ohio River valley communities, most supplies of groundwater in West Virginia are derived from wells that penetrate bedrock. These systems generally cannot supply large populations reliably, but they do supply water to many small communities in West Virginia where surface water has not been impounded, is polluted, or is an unreliable source during the dry periods of the year. In the coal mining areas, the important aquifers typically are sandstones and conglomerates that are associated with coal seams.

Many of the groundwater-based systems are located in the southern part of the State (Verbally, Mr. James Hodges, 15 December 1976). Wells may penetrate deep mines, mine sumps, or strata where deep mines are located. Because the sulfur content of coal in southern West Virginia generally is low, the pH of the groundwater generally meets public health standards, but treatment may be required to reduce its iron or manganese content.

Table 31. Sources of potable water for communities with population of 9,000 or greater. Counties marked with an asterisk (*) are surface-coal producing counties. 1973 data are from the West Virginia Department of Health.

COUNTY	COMMUNITY	SOURCE	POPULATION SERVED
Berkeley	Martinsburg	Kilmer Springs	18,400
Brooke	Weirton	Ranney Wells	35,000
Cabell	Huntington	Ohio River	120,000
Fayette*	Oak Hill	Wells	10,962
Harrison*	Clarksburg	West Fork River	43,368
Kanawha*	Charleston	Elk River	170,000
Kanawha*	Saint Albans	Coal River	20,000
Logan *	Logan	Guyandotte River	15,800
Marion*	Fairmont	Tygart River	40,000
Marion*	Monongah	Tygart River	10,000
Marshall	Moundsville	4 Wells	17,000
Mason	Point Pleasant	Wells	10,000
Mercer*	Bluefield	Impoundments	17,498
Mercer*	Princeton	Impoundment	11,781
Mingo*	Williamson	Tug River	9,500
Monongalia*	Morgantown	Monongahela River	40,000
Ohio	Wheeling	Ohio River	65,000
Raleigh*	Beckley	Glade Creek	60,000
Randolph*	Elkins	Tygart River	11,000
Upshur*	Buckhannon	Buckhannon River	9,000
Wood	Parkersburg	5 Ranney Wells	60,000
Wood	Vienna	Wells (Ohio River)	12,000

Surface mining may disrupt groundwater flow, lower local water tables, intercept aquifers, and pollute aquifers if the mining activity enhances acid production. The potential for these problems is greatest where surface mining occurs in an aquifer recharge area.

Bedrock aquifers commonly are overlain by impermeable shales in West Virginia, so that recharge areas are present only where erosion has removed the shale and exposed an aquifer to infiltration. These areas include anticlines that have been breached by erosion, such as the Chestnut Ridge Anticline in the Monongahela River Basin.

No studies of the impact of surface mining on groundwater systems in West Virginia have been located. Nonetheless, in areas where groundwater from bedrock is an important source of water, specific reviews of potential groundwater impact are appropriate to individual mine applications. In particular, local perched water tables should be identified, because they may provide local supplies of potable water. The blasting and excavations associated with surface coal mining may disrupt local aquifers and terminate sources that traditionally were used in the vicinity of surface mines.

Floodprone Areas

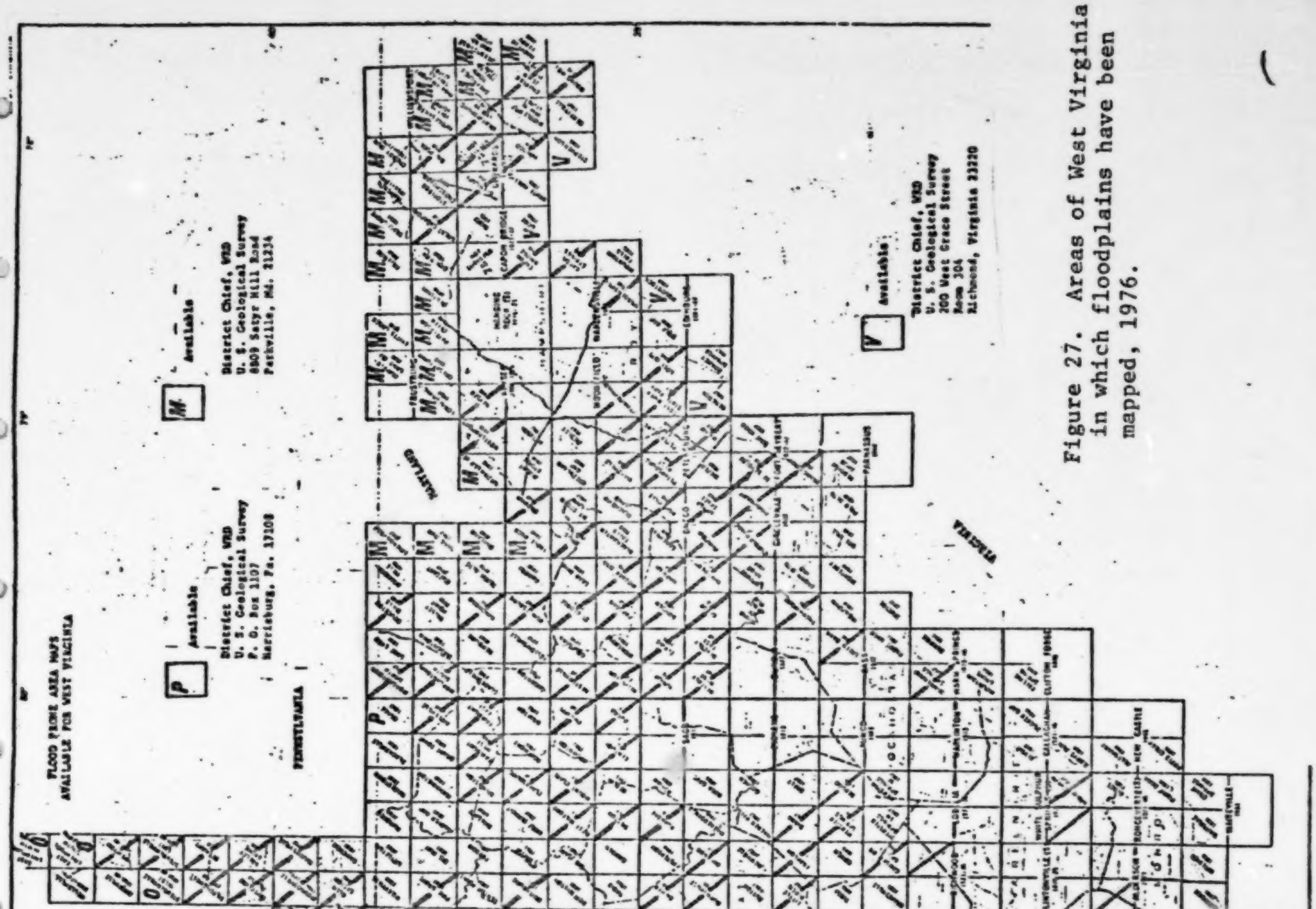
Floodprone areas are defined as those areas which are projected to be flooded during a flood with an expected recurrence of once each 100 years. Under contract to the Federal Flood Administration, the US Geological Survey is mapping the floodprone areas of West Virginia on 7.5-minute topographic quadrangles. As of 1976, 232 floodprone area maps of the State were available (Figure 27, Table 32).

Floodprone areas generally are not greatly affected by surface mining operations, unless large quantities of overburden are lost during landslides. Water ponded above landslides can cause upstream flooding, and can flow over downstream areas if the landslide gives way suddenly. Surface mines in West Virginia typically are located on the slopes of valleys, so accelerated runoff from surface mines also may affect floodprone areas. If road or other construction activities are induced in the areas surrounding surface mines, runoff and sedimentation from such areas also may affect downstream floodplains.

Except in some areas where flat hilltops occur, floodplains typically are the only low-slope areas in West Virginia, so there may be economic pressure to develop them. Extensive surface mining in a region indirectly may induce construction of support facilities on floodprone sites. These may include coal-cleaning facilities, other industrial or commercial facilities, and housing for workers and their families. Such facilities can usurp the best agricultural land in West Virginia. They can also reduce the flood storage capabilities of floodplains, especially if dikes are constructed to prevent flood damage to the facilities.

Wetlands

Wetlands generally larger than 40 acres in extent were inventoried by the WV-DNR during the early 1950's (US-FWS 1954). This inventory covered only a few parts of the State. Altogether 3,810 acres of wetlands were delineated in Preston, Tucker, Pocahontas, and Greenbrier Counties. Fresh meadows constituted 27% of the total; shrub swamps, 25%; wooded swamps, 45%; and bogs, 3%. The occurrence of these types by county is indicated in Table 33 . Particular attention was called to wetlands in the headwaters of Muddy Creek in eastern Preston County, to the Canaan Valley in the upper Blackwater River watershed of eastern Tucker County, to the upper Cranberry River watershed of western Pocahontas County, and to the upper Meadow River and tributaries in western Greenbrier County. Although wetlands are relatively scarce in West Virginia, this inventory should not be regarded as exhaustive.


FLOOD PRONE AREA MAPS
AVAILABLE FOR WEST VIRGINIA
Available
District Chief, WRD
U. S. Geological Survey
3303 Federal Building
500 Quarrier Street
Charleston, W. Va. 25301
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Available
District Chief, WRD
U. S. Geological Survey
975 West Third Avenue
Columbus, Ohio 43212
K
Available
District Chief, WRD
U. S. Geological Survey
Room 572 Federal Building
600 Federal Place
Louisville, Kentucky 40202
P
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District Chief, WRD
U. S. Geological Survey
P. O. Box 1107
Harrisburg, Pa. 17108
M
Available
District Chief, WRD
U. S. Geological Survey
8809 Satyr Hill Road
Parkville, Md. 21234
V
Available
District Chief, WRD
U. S. Geological Survey
200 West Grace Street
Room 304
Richmond, Virginia 23220
PENNSYLVANIA
OHIO
MARYLAND
VIRGINIA
KENTUCKY

Figure 27. Areas of West Virginia in which floodplains have been mapped, 1976.

Table 32. Topographic quadrangles in West Virginia for which floodprone areas have been mapped, 1976.

1. Alderson
2. Alum Creek
3. Amherstdale
4. Anawalt
5. Annamoriah
6. Apple Grove
7. Arnett
8. Arnoldsburg
9. Athens
10. Audra
11. Baileysville
12. Bancroft
13. Barboursville
14. Barnabus
15. Beckley
16. Beckwith
17. Belington
18. Belle
19. Bens Run
20. Bergoo
21. Bethany
22. Beverly East
23. Beverly West
24. Big Chimney
25. Big Creek.
26. Big Pool
27. Blue Creek
28. Bowden
29. Bradshaw
30. Bramwell
31. Branchland
32. Brandywine
33. Bruceton Mills
34. Burington, W V
35. Burning Springs
36. Burnsville
37. Businessburg
38. Cairo
39. Camden on Gauley
40. Capon Bridge
41. Capon Springs
42. Cedar GRove
43. Cedarville
44. Century
45. Chapmanville
46. Charleston East
47. Charleston West
48. Charles Town
49. Cheshire
50. Circleville
51. Clarksburg
52. Clio
53. Clothier
54. Cottageville
55. Davis
56. Davy
57. Delbarton
58. Diana
59. Dorothy
60. Elizabeth
61. Elkins
62. Elmwood
63. Erbacon
64. Eskdale
65. Fairmont East
66. Fairmont West
67. Fayetteville
68. Franklin
69. Forest Hill
70. Fort Seybert
71. Fort Springs
72. Gallipolis (Ohio)
73. Garretts Bend
74. Gary
75. Gauley Bridge
76. Gilbert
77. Gilmer
78. Girta
79. Glady
80. Glen Easton
81. Glengary
82. Glenville
83. Glenwood
84. Gorman (Md.)
85. Grantsville
86. Great Cacapon
87. Green Bank
88. Griffithsville
89. Hager
90. Hamlin
91. Harman
92. Harrisville
93. Henlawson
94. Hinton
95. Holden
96. Hopeville
97. Huntington
98. Hurricane
99. Iaeger
100. Inwood
101. Julian
102 Junior
103. Kanawha
104. Keyser
105. Keystone
106. Kingwood
107. Lavalette
108. Lewisburg
109. Little Birch
110. Logan
111. Lorado
112. Lost City
113. Lost River State Park
114. Lubeck
115. Macfarlan
116. Madison
117. Majestic
118. Majorsville
119. Mallory
120. Man
121. Martinsville
122. Matewan (Ky.)
123. Matheny
124. Maysville
125. McGraws
126. Meadow Creek
127. Middlebourne
128. Milam
129. Millstone
130. Milton
131. Minnehaha Springs
132. Montgomery
133. Moorefield
134. Morgantown North
135. Morgantown South
136. Moundsville
137. Mount Clare
138. Mozart Mountain

Table 32. Topographic quadrangles in West Virginia (concluded).

139. Mullens
140. Myrtle
141. Naugatuck
142. Nestorville
143. New Haven
144. New Martinsville
145. New Matamoras (Ohio)
146. Normantown
147. Oceana
148. Old Field
149. Onego
150. Orlando
151. Paden City
152. Panther
153. Parkersburg
154. Parsons
155. Petersburg East
156. Petersburg West
157. Petroleum
158. Philippi
159. Pine Grove
160. Pineville
161. Pocatalico
162. Pond Creek
163. Porters Falls
164. Powellton
165. Powhaton Pt.
166. Prince
167. Quick
168. Racine
169. Ranger
170. Raven Rock (Ohio)
171. Ravenswood
172. Reedy
173. Rhodell
174. Richwood
175. Rig
176. Ripley
177. Rivesville
178. Roanoke
179. Robertsburg
180. Romance
181. Ronceverte
182. Rosedale
183. Round Hill
184. Rowlesburg
185. Saint Albans
186. Saint George
187. Sandyville
188. Scott Depot
189. Shinnston
190. Shirley
191. Sissonville
192. Smithburg
193. Smithville
194. South Parkserburg
195. Spring Field
196. Steubenville East
197. Sugar Grove
198. Sylvester
199. Tablers Station
200. Talcott
201. Tanner
202. Thornwood
203. Thurmond
204. Tiltonsville (Ohio)
205. Upper Tract
206. Valley Grove
207. Valley Mills
208. Walton
209. War
210. Wardensville
211. Webb
212. Webster Springs
213. Weirton
214. Welch
215. Westernport
216. West Hamlin
217. West Milford
218. Weston
219. West Union
220. Wharncliffe
221. Wharton
222. Wheeling
223. White Sulphur Springs
224. Whitesville
225. Whitmer
226. Williams Mountain
227. Williamson (Ky.)
228. Willow Island
229. Winfield
230. Winona
231. Winslow
232. Yellow Springs

Table 33. Acreage of major wetlands in West Virginia (US-FWS 1954).

County	Fresh Meadow	Shrub Swamp	Wooded Swamp	Bog	Total
Greenbrier	250	180	1,470	0	1,900
Pocahontas	0	290	30	130	450
Preston	0	60	210	0	270
Tucker	780	410	0	0	1,190
Total	1,030	940	1,710	130	3,810

Critical Habitats for Imperiled Species

Federal Designation

No species of plant has yet been determined to be endangered or threatened in accordance with Section 4 of the Endangered Species Act of 1973 (16 USC 1531-1543, 87 Stat. 884). About 1,700 vascular plant taxa have been proposed for such classification by the US Department of the Interior (41 FR 24523-24572, 16 June 1976). The known range of none of these plants, as listed by the Department of the Interior, includes West Virginia.

Animals listed as endangered which are listed as inhabiting West Virginia include the following: Indiana bat (*Myotis sodalis*), longjaw cisco (*Coregonus alpenae*), arctic peregrine falcon (*Falco peregrinus tundrius*), Bachman's warbler (*Vermivora bachmanii*), and tuberculed-bottom pearly mussel (*Epioblagma torulosa torulosa*). No threatened West Virginia species was listed by the Fish and Wildlife Service during 1976 under the Endangered Species Act (41 FR 4339-43358, 30 September 1976).

Critical areas have been designated pursuant to Section 7 of the Endangered Species Act of 1973 for only one species among those listed in the preceding paragraph, the Indiana bat. To date the Department of the Interior has designated only Hellhole Cave in Pendleton County, West Virginia, a moratorium county for surface coal mining which has no surface minable coal resources (41 FR 41916, 24 September 1976).

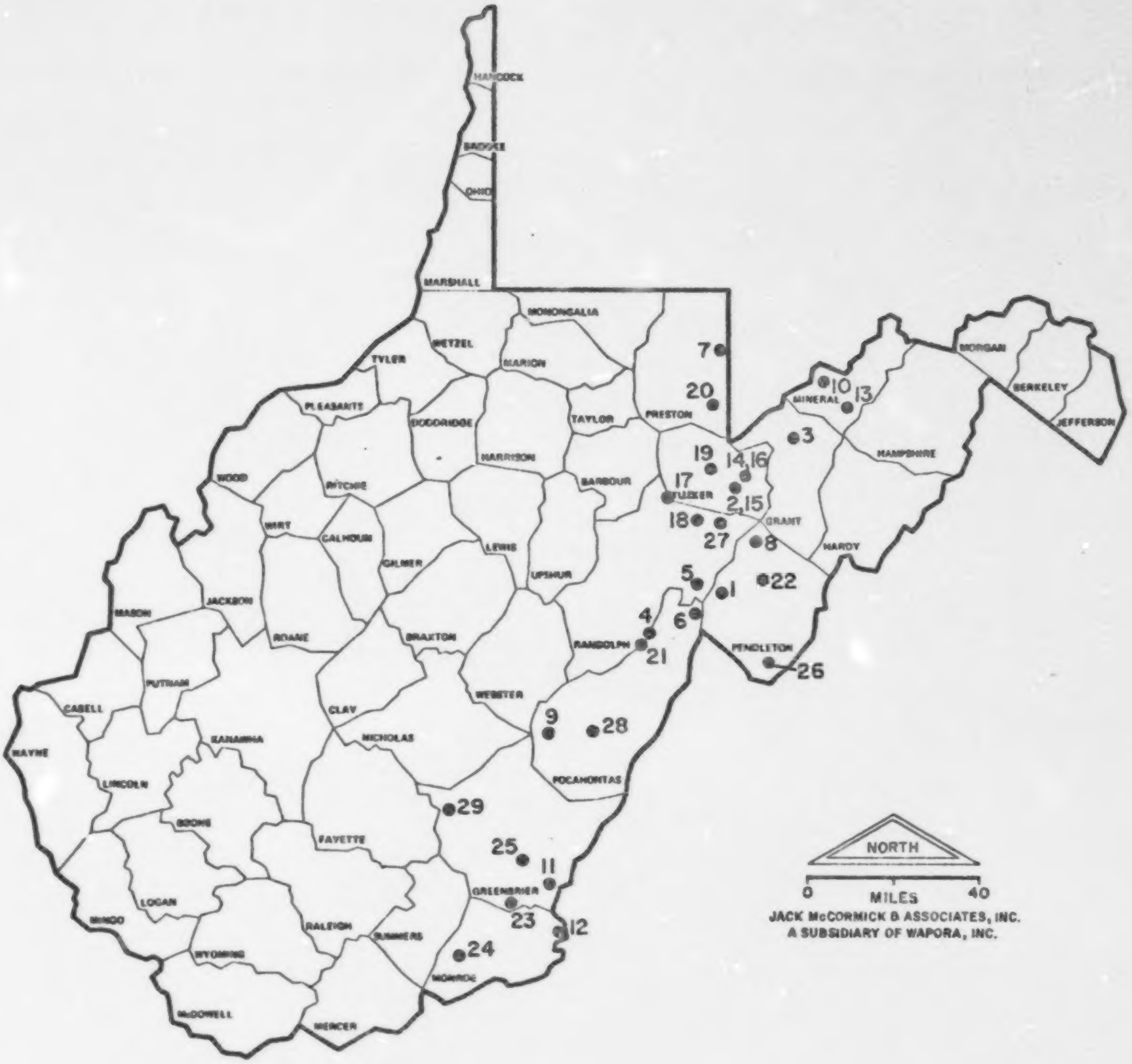
Indiana bats are known to inhabit Big Springs Cave and Cave Hollow Cave within Monongahela National Forest (USFS 1977:31). The Forest Service has installed gates on Big Springs Cave, but Cave Hollow Cave is accessible from private land as well as from Federal land. The peregrine falcon formerly inhabited the Forest, and populations may be reestablished on suitable cliffs (USFS 1977:31).

State Designation

The State of West Virginia has no legislation protecting imperiled biota specifically. The WV-DNR publishes no lists of plants or wildlife categorized by endangerment status in the State, and has not designated critical habitats. State attention has been given primarily to harvestable species of fish and game.

Areas of General Biological Interest

The known stands of unusual vegetation in West Virginia are presented in Table 34 and Figure 28. Two of these areas are listed by the National Park Service as National Natural History Landmarks, and 13 additional sites have been declared eligible for such listing (40 FR 19508, 5 May 1975). No further sites currently are being processed for History Landmark eligibility determinations (Verbally, Mr. John Bond, Mid-Atlantic Region, National Park Service, 17 December 1976). In general the biotic resources of a surface mined site are destroyed completely by mining operations. Although some vegetation may be reestablished in accordance with State reclamation requirements, and game animals may use such habitat, the post-mining biota bears little if any resemblance to pre-mining conditions. Post-mining conditions are not appropriate for plant and animal communities of high biological interest until many decades have elapsed.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MONONGALIA
WETZEL
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MARION
PLEASANTS
DODDRIDGE
TAYLOR
PRESTON
HARRISON
BARBOUR
WOOD
RITCHIE
TUCKER
WIRT
CALHOUN
GILMER
LEWIS
UPSHUR
MASON
JACKSON
ROANE
BRAXTON
RANDOLPH
PUTNAM
CABELL
CLAY
WEBSTER
WAYNE
KANAWHA
NICHOLAS
POCAHONTAS
LINCOLN
BOONE
FAYETTE
GREENBRIER
LOGAN
MINGO
RALEIGH
SUMMERS
WYOMING
MONROE
McDOWELL
MERCER
MINERAL
HAMPSHIRE
GRANT
HARDY
PENDLETON
MORGAN
BERKELEY
JEFFERSON
7
20
10
13
3
19
14
16
17
2
15
18
27
8
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1
22
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9
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25
11
23
12
24
NORTH
0
MILES
40
JACK McCORMICK & ASSOCIATES, INC.
A SUBSIDIARY OF WAPORA, INC.

Figure 28. Sites of unusual biological interest in West Virginia. The sites are described in Table 34.

Table 34. Sites of unusual biological interest in West Virginia (USFS 1977:27; Core 1966; Goodwin and Niering 1975; 40 FR 19508). Acreages of eligible (*) or registered (**) National Natural History Landmarks were provided by Mr. John Bond, National Park Service, Philadelphia PA, 17 December 1976. Map numbers refer to Figure 28. MNF indicates that the site is within the Monongahela National Forest. + indicates area specially classified by the US Forest Service.

Map No.	Name	Acreage	County	Remarks
1	Spruce Knob (MNF)		Pendleton	Sparse red spruce, 10-15 feet tall, 50 years old
2	Canaan Valley *	15,400	Tucker	Numerous bogs, ponds; rhododendron thickets; balsam fir
3	Stony River Dam		Grant	Balsam fir at damsite
4	Blister Run Swamp*+ (MNF)	280	Randolph	Sphagnum bog with balsam fir
5	Sinks of Gandy (Private land, MNF)	50	Randolph	Sphagnum glade with red spruce and mixed deciduous trees, twin flower, dwarf cornel, skunk currant, snowberry
6	Blister Swamp	40	Pocahontas	Sphagnum bog with balsam fir, twinflower
7	Cranesville Swamp Nature Sanctuary**+ (MNF)	251 (WV)	Preston	Bog with tamarack, black spruce, and other northern biota
8	Heath Barrens		Pendleton	Ericaceous scrub plains, several thousand acres
9	Cranberry Glades Botanical Area*	750	Pocahontas	Five glades with forest, peat 11 feet deep
10	Pine Swamp		Mineral	Sphagnum bog
11	White Sulphur Springs Shale Barrens		Greenbrier	Endemic plants
12	Sweet Springs Shale Barrens		Monroe	Endemic plants

Table 34. Sites of unusual biological interest in West Virginia (continued).

Map No.	Name	Acreage	County	Remarks
13	Burlington Shale Barrens		Mineral	Endemic plants
14	Dobbin Slashing		Tucker	Alder sphagnum bog with red spruce
15	Fisher Spring Run* (in Dolly Sods Scenic Area+, MNF)	410	Tucker	Sphagnum bog with beaver
16	Red Run	100	Tucker	Red spruce and sphagnum
17	Moore Run	25	Randolph	Sphagnum glade with beaver
18	Yellow Creek	30	Randolph	Glade 3 miles from nearest road
19	Big Run Bog* (MNF)+	1,640	Tucker	Sphagnum, hemlock, red spruce
20	Cathedral Park**	136	Preston	
21	Gaudineer Scenic Area* + (MNF)		Pocahontas	250-year old red spruce forest
22	Germany Valley Karst Area*	8,200	Pendleton	
23	Greenbrier Caverns*	2,100	Greenbrier	
24	Greenville Saltpeter Cave*	81	Monroe	
25	Lost World Caverns*	470	Greenbrier	
26	Sennett-Thorn Mountain Cave System*	80	Pendleton	
27	Shavers Mountain Spruce-Hemlock Stand* (in Otter Creek Wilderness Area)	190	Randolph	
28	Swago Karst Area*	6,400	Pocahontas	
29	Greenbrier County Wetlands	1,900	Greenbrier	Mixed swamp forest

Table 34. Sites of unusual biological interest in West Virginia (concluded).

Name	Acreage	County	Remarks
North Fork Mountain	50	Pendleton	Red pine forest
South Branch Mountain		Hardy	Small stand red pine forest
Ice Mountain		Hampshire	Twinflower in talus
Spruce Mountain		Pendleton	Grassy bald
Bald Knob		Tucker	
Bald Knob		Pocahontas	
New Creek Mountain		Mineral	Dwarf deciduous forest
Cowen Glade		Webster	Sphagnum glade
Glady		Randolph	
Clade Farms		Preston	
Gum Springs Bog		Monongalia	
Cranberry Flat		Randolph	
Pine Swamp		Mineral	
Fanny Bennett Hemlock Grove (MNF)	70		Virginia hemlock stand
Elklick Cave (MNF)			Bat population
Cave Mountain Cave (MNF)			Largest known Virginia big-eared bat population in eastern US
Black Mountain Rhododendron Stand (MNF)			Purple rhododendron stand
Showy Lady Slipper Orchid Area (MNF)	0.1		Stand of _Cypripedium reginae_
White Pine Natural Area (MNF)	9		Virgin white pine stand
Big Springs Cave (MNF)		Tucker	Population of Indiana bats

Computerized Inventory System

A computerized inventory of natural features is being compiled by the Nature Conservancy in cooperation with the WV-DNR. This inventory covers the entire State, and is part of the West Virginia Heritage Trust Program. The information accumulated by this system now comprehends about 1,600 entries that consist of aquatic habitats, geologic features, exceptional individual organisms, plant communities, and populations of endangered or threatened species. The descriptive information on such features is combined with data on geographic location, protection status, ownership, and date of observations. Because data can be retrieved rapidly by watershed, topographic quadrangle, or latitude and longitude, it is possible to have the computer search for features within any desired radius of a proposed surface mine site.

The system is not yet fully operational, and the inventory will never be complete, but the opportunity offered by this system for efficient impact assessment is substantially in advance of that offered in most States. The system is expected to be operationalized during 1977 (Verbally, Mr. Frank Pelurie, The Nature Conservancy, Charleston, 11 December 1976).

Prime Agricultural Lands

In West Virginia about 22% of the inventoried acreage is suitable for cultivation with varying degrees of limitations on use and varying amounts of conservation treatments (SCS 1970). The remainder is best suited for permanent vegetation such as permanent pasture or forest. There is some farming of lands which are incapable of sustaining continued cultivation.

West Virginia topography has prevented the development of extensive areas of high-quality cropland, particularly in those counties where the surface mining of coal is a significant activity. The 29 counties in which surface mining is practiced contained 58% of the land area of the State, but only 42% of the acreage in crops and 48% of the acreage in pasture, during 1967 (Table 34). Forested land in these counties represented 60% of the State total, and "other" land (about half of which in these counties is surface-mined land) accounted for 72% of the State total.

The Soil Conservation Service classifies land according to its suitability for various kinds of farming, based on limitations of the soils, the risk of damage when they are used, and the way they respond to treatment. The broadest grouping in the classification is the Capability Class, designated by Roman numerals I through VIII. These numbers indicate progressively greater limitations and narrower choices for practical use. Capability subclasses, designated by small letters, show the nature of the main limitation on use.

Class I

Soils in Class I have few limitations that restrict their use. Soils in this class are suited to a wide range of plants, and may be used safely for cultivated crops, pasture, woodland, and wildlife. The soils are nearly level, and erosion hazard is low. They are deep, generally well drained, and easily worked. They hold water and are either fairly well supplied with plant nutrients or highly responsive to inputs of fertilizer.

The soils in Class I are not subject to damaging overflow. They are productive and suited for intensive cropping. They typically are used for crops and need ordinary management practices to maintain soil fertility and soil structure. For productivity such practices may include the use of one or more of the following: fertilizers and lime, cover and green-manure crops, conservation of crop residues and animal manures, and sequences of adapted crops.

Capability subclass designations are not applied to Class I lands.

Table 35. 1967 land use acreage in surface coal mining counties of West Virginia (SCS 1970). The classification is based on a statistically randomized sample survey. Urban land includes built-up areas greater than 10 acres, industrial sites (excluding surface mines), railroad yards, cemeteries, airports, golf courses, and related lands. Water includes reservoirs, ponds, and lakes greater than 40 acres, and rivers wider than 0.125 mile. Forest includes both commercial and non-commercial timbered lands. Other land includes surface mines, farmsteads, farm roads, rural non-farm residences, and fencerows. About 190,000 acres of surface-mined land were inventoried Statewide.

	NOT INVENTORIED			INVENTORIED				TOTAL
County	Federal	Urban	Water	Cropland	Pasture	Forest	Other	
Barbour	0	5,998	400	22,180	42,592	130,327	13,543	215,040
Boone	0	9,800	600	1,100	2,100	290,000	17,000	320,600
Braxton	10,500	6,100	900	31,981	55,874	213,633	11,912	330,900
Brooke	0	7,600	100	8,600	5,500	23,900	11,300	57,000
Clay	0	3,200	1,500	8,139	13,923	189,350	2,788	218,900
Fayette	0	15,160	2,600	14,100	21,300	352,400	16,200	421,760
Gilmer	0	3,999	300	16,026	26,344	167,468	2,863	217,000
Grant	14,529	3,015	650	15,603	41,212	219,014	10,167	304,190
Greenbrier	99,350	9,542	2,530	32,455	102,527	401,860	8,216	656,480
Hancock	0	11,100	0	7,600	4,000	24,600	5,200	52,500
Harrison	0	13,509	1,000	30,534	68,109	115,079	39,289	267,520
Kanawha	400	49,700	3,400	12,100	33,900	453,500	28,100	581,100
Lewis	0	5,187	322	18,100	71,591	134,300	21,400	250,900
Logan	0	14,100	500	1,200	2,500	260,500	13,000	291,800
McDowell	0	16,821	400	1,000	2,999	302,200	17,700	341,120
Marion	0	14,800	700	12,000	38,000	120,000	12,300	197,800
Mercer	0	14,702	1,100	15,470	32,000	186,445	17,183	266,900
Mineral	438	4,394	645	19,223	26,200	156,900	3,400	211,200
Mingo	0	12,512	500	1,700	300	242,300	13,408	270,720
Monongalia	500	12,505	500	16,608	25,881	144,940	32,566	233,500
Nicholas	30,100	6,826	400	24,045	20,950	312,923	17,356	412,600
Preston	3,900	10,493	2,120	42,400	58,900	247,200	21,287	412,800
Raleigh	0	21,230	1,000	25,494	30,852	295,115	12,539	386,230
Randolph	170,400	10,393	1,300	33,544	50,945	382,218	13,300	663,100
Taylor	0	4,000	300	11,495	26,864	55,900	10,241	108,800
Tucker	93,000	4,000	300	9,000	13,500	139,600	10,000	269,400
Upshur	0	5,000	500	23,814	52,996	131,400	11,590	225,300
Webster	64,700	3,311	500	7,232	6,238	266,099	4,520	352,600
Wyoming	0	8,563	2,300	6,500	9,500	287,637	8,100	322,600
Subtotal	487,817	307,560	27,367	469,243	887,597	6,247,808	406,468	8,860,360
West Virginia	947,132	468,419	47,561	1,105,930	1,836,993	10,429,867	565,818	15,401,780
Subtotal as % of State Total	52	66	58	42	48	60	72	58

Class II

Soils in Class II have some limitations that reduce the choice of plants or require moderate conservation practices. Soils in this class require careful soil management, including conservation practices, to prevent deterioration or to improve air and water relations when the soils are cultivated. The limitations are few, and the practices are easy to apply. The soils may be used for cultivated crops, pasture, woodland, or for wildlife food and cover.

Limitations of soils in Class II may include singly or in combination the effects of (1) gentle slopes, (2) moderate susceptibility to erosion or moderate adverse effects of past erosion, (3) less than ideal soil depth, (4) somewhat unfavorable soil structure and workability, (5) occasional damaging overflow, and (6) wetness which can be corrected by drainage but existing permanently as a moderate limitation.

The soils in this class provide the farm operator less latitude in the choice of either crops or management practices than soils in Class I. They may also require special soil conserving cropping systems, soil conservation practices, water control devices, or tillage methods when used for cultivated crops.

Capability subclasses recognized in West Virginia are: e, erosion hazard; w, wetness; and s, shallowness and/or stoniness.

Class III

Soils in Class III have severe limitations that reduce the choice of cultivated plants, require special conservation practices, or both.

Soils in Class III have more restrictions than those in Class II, and when used for cultivated crops, the conservation practices are usually more difficult to apply and to maintain. They may be used for cultivated crops, pasture, woodland, or for wildlife food and cover.

Class III soils were not tabulated for this report. Data on them may be found in Soil Conservation Service (1970).

Valuable Farmland

The latest data, collected during 1967, indicate that 7% of West Virginia as a whole was used for crop production, but only 5% of the 29 surface mining counties was cropped (Table 36). The percentage of total land in the surface mining counties that was classified as I or II ranged from 1% in Logan, McDowell, Mingo, and Webster Counties to 16% in Hancock and Preston Counties. Overall, only 5% of the land in the surface mining counties was classed as I or II, the same proportion as in West Virginia as a whole. In some counties there was substantially less land used to produce crops than there was high-quality cropland (e.g., Boone, Logan, and McDowell Counties), whereas other counties had much more acreage of active cropland than their actual acreage of high-quality land (e.g., Barbour, Brooke, Harrison, and Taylor Counties; Table 36).

Class I and II soils by definition are situated on slopes no steeper than 8%. In the surface mining areas of West Virginia such soils are situated almost entirely in stream valleys.

Surface mining activities are more likely to affect steep, nonagricultural lands in West Virginia than to disrupt high-class farmland, so long as landslides are prevented by proper mining techniques. Certain surface mining methods, such as the mountaintop removal which is practiced increasingly in the southern West Virginia coalfields, may create extensive areas of quality farmland, if sound reclamation measures are used.

Table 36. High-quality farmland that potentially could be affected by surface coal mining in West Virginia (SCS 1970). Acreage data are for 1967. See text for explanation of classification.

COUNTY	Land In Crops	Percent of Total Land	Class I	Class IIe	Class IIw	Class IIs	Total High Quality Land	High Quality Land as % of Total Land	High Quality Land as % of Land in Crops
Barbour	22,180	10	0	8,636	1,374	0	10,010	5	45
Boone	1,100	0	0	1,257	7,511	2,070	10,838	3	985
Braxton	31,981	10	2,162	4,368	12,284	0	18,814	6	59
Brooke	8,600	15	219	3,018	700	0	3,937	7	46
Clay	8,139	4	0	1,335	3,687	0	5.022	2	62
Fayette	14,100	3	0	18,673	1,824	2,026	22,523	5	160
Gilmer	16,026	7	1,539	2,076	8,132	0	11,747	5	73
Grant	15,603	5	1,899	12,085	1,715	620	16,319	5	105
Greenbrier	32,455	5	0	28,883	2,810	0	31,693	5	98
Hancock	7,600	14	0	5,754	464	2,010	8,228	16	108
Harrison	30,534	11	1,068	7,046	5,767	0	13,881	5	45
Kanawha	12,100	2	245	2,596	9,824	2,073	14,738	3	122
Lewis	18,100	7	0	9,627	6,844	1,217	17,688	7	98
Logan	1,200	0	0	0	3,869	0	3,869	1	322
McDowell	1,000	0	0	539	1,467	1,067	3,073	1	307
Marion	12,000	6	0	5,980	3,304	0	9,284	5	77
Mercer	15,470	6	0	16,260	1,032	507	17,799	7	115
Mineral	19,223	9	1,227	6,898	7,027	0	15,152	7	79
Mingo	1,700	1	0	0	3,852	0	3,852	1	227
Monongalia	16,608	7	0	6,470	3,883	0	10,353	4	62
Nicholas	24,045	6	795	15,456	3,740	0	19,991	5	83
Preston	42,400	10	633	55,837	7,601	0	64,071	16	151
Raleigh	25,494	7	0	15,473	2,351	1,297	19,121	5	75
Randolph	33,544	5	2,046	16,411	7,682	4,925	31,064	5	93
Taylor	11,495	11	0	3,399	1,455	0	4,854	4	42
Tucker	9.000	3	824	10,862	978	1,515	14,179	5	158
Upshur	23,814	11	0	9,934	2,552	0	12,486	6	52
Webster	7,232	2	0	2,531	2,431	0	4,962	1	69
Wyoming	6,500	2	0	2,806	4,761	887	8,454	3	130
Subtotal	456,843	5	12,657	274,210	120,921	20,214	428,002	5	94
West Virginia	1,105,930	7	61,930	550,973	339,148	46,202	998,253	6	90

Caverns

Caverns are of recreational value to an increasing number of speleologists and also can provide habitats for imperiled biota. They are known to occur in 11 of the 29 counties where surface mining of coal currently is practiced. Surface mining activity, which includes construction of haul roads, can affect caverns adversely by sealing entrances, altering the groundwater hydrology, or otherwise altering their aesthetic qualities.

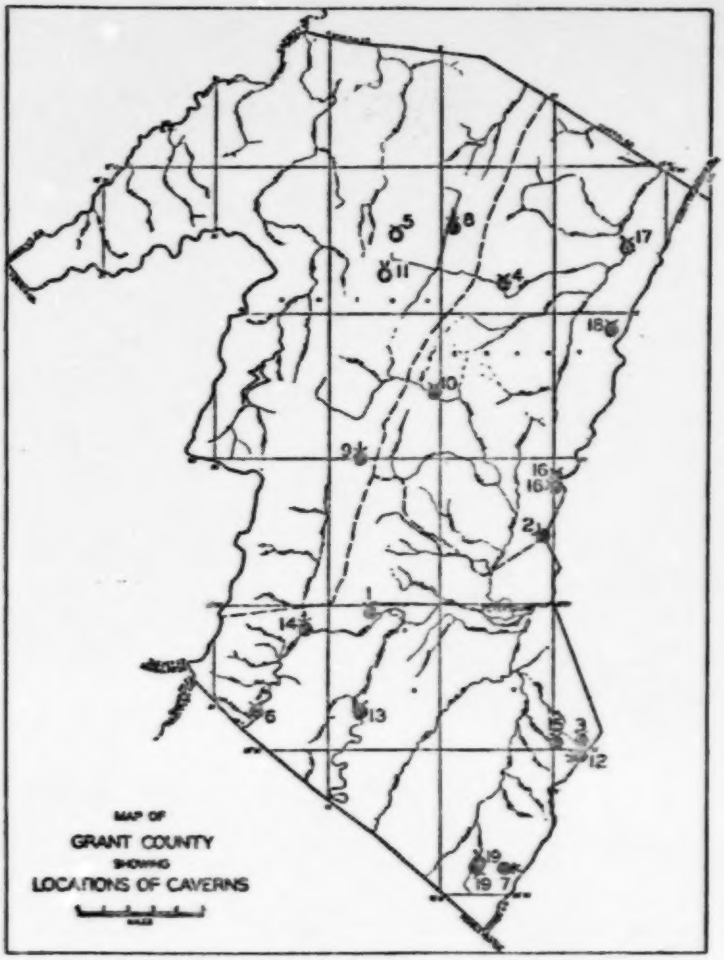
All West Virginia caves reported by Davies (1958, 1965) are located in the Mississippian-age Greenbrier Limestone or older strata, with the exception of the following:

McKinney Cave (Preston County, Pottsville Formation),
Cooper Rock Cave (Monongalia County, Pottsville Formation), and
Indian Cave (Harrison County, Monongahela Formation).

Thus, except for the caves noted above, there is a stratigraphic separation of caves from coal bearing strata. In addition, the caves that have been located on county maps (Figures 29 through 37) are separated geographically from surface coal mining areas for a distance of 5 miles or more in Grant, Greenbrier, and Mercer Counties. One or more caves in Harrison, Mineral, Monongalia, Preston, Randolph, and Tucker Counties are located within 5 miles of a surface mine or area where surface mining might occur. In these areas potential surface mines are located topographically above the cave openings; thus haul roads, drainage ways, or sediments from the mining activity may have adverse impacts on this natural resource.

Caves are included on the computerized inventory of natural resources currently being developed jointly by the WV-DNR and The Nature Conservancy. This inventory will provide an efficient means to identify caves in the local vicinity of proposed surface mines. Recent studies of caves in the current coal-producing counties include those of Garton and others (1976; Barbour, Harrison, Marion, Monongalia, Ohio, and Preston Counties), Jones (1973, Greenbrier County), and Medville and Medville (1971, Randolph County). Monroe County caves (Hempel 1975) and Pocahontas County caves (Medville and Medville 1976; Werner 1972) also have received attention.

Caves are afforded no special protection by State or local statute in West Virginia. The Forest Service has installed gates at Big Springs Cave.


MAP OF
GRANT COUNTY
SHOWING
LOCATIONS OF CAVERNS
5
8
17
11
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18
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16
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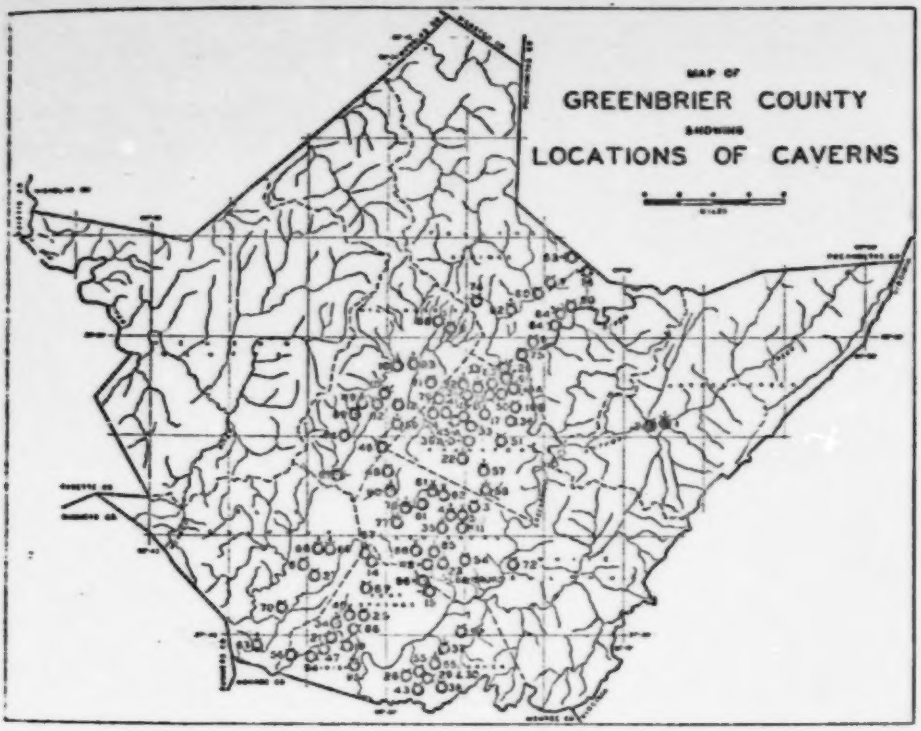
19
7

1. Cedar Hill.
2. Charles Knob.
3. Deaheart.
4. Greenland Gap.
5. Hanline.
6. Jim.
7. Kesner.
8. Kessel.
9. Klines Gap.
10. Mays Gap.
11. Munsing.
12. Mongold (Elkhorn Mountain).
13. Peacock.
14. Smokehole Caverns.
15. Spring Run.
16. Veach.
17. Williamsport Marl Caves.
18. Wolf Den Rocks.
19. Wolfpen Caves.

Figure 29. Caves in Grant County, West Virginia (Davies 1965).



1. Alvon.
2. Anthony.
3. Arbuckle.
4. Arbuckle School.
5. Arbuckle Shafts.
6. Asbury.
7. Ballard Mountain.
8. Bob Gee.
9. Bone.
10. Bransfords.
11. Brants.
12. Brushy Ridge.
13. Buckeye Creek.
14. Bungers.
15. Burnholt.
16. a, b, Burns No. 1 and No. 2.
17. Cabble.
18. Cadle.
19. Carlisle.
20. Cave Farm.
21. Cliff.
22. Coffman.
23. Court Street.
24. Culverson Creek.
25. Davis.
26. Erwins.
27. Feamster.
28. Fox.
29. Foxhole No. 1.
30. Foxhole No. 2.
31. Fuells Drop.
32. Fuells Fruit.
33. Fuller.
34. General Davis.
35. Grapevine.
36. Hanna.
37. Hedricks.
38. Hellems.
39: a,b,c,d, Higginbothams Nos. 1-4.
40. Highlander Ridge.
41. Hinkles Unus.
42. Horse Pit.
43. Hoyt.
44. Hughart.
45. a, b, Jackson No. 1 and No. 2.
46. Jarrets Water.
47. Jewel.
48. Johnson.
49. Judys.
50. Leggs.
51. Levisay.
52. Lewis.
53. Lewis Hole.
54. Lipps.
55. Lipps No. 2.
56. Lost.
57. Ludington.
58. McClung.
59. McFerrin.
60. McMillan.
61. Madison Knob, North.
62. Madison Knob, South.
63. Muddy Creek.
64. Norman.
65. Organ.
66. Parlor.
67. Pecks.
68. Piercys.
69. Piercys Mill.
70. Pollock & Pollock Saltpeter.
71. Poor Farm.
72. Rambows.
73. Rapps.
74. Reinhold.
75. Renick Bridge.
76. Renicks Valley Pit.
77. Richlands.
78. Richlands Northfield.
79. Scout Camp.
80. Seldomridge.
81. Simms.
82. Sinks of Sinking Creek.
83. Spencer.
84. Taylor No. 1.
85. Taylor No. 2.
86. Taylor Falls.
87. Thornbury.
88. Thrasher.
89. Tower.
90. Tuckwiller.
91. U. S. 219.
92. Walton.
93. Water.
94. Wilson Bluff.
95. Wind.
96. Yorks.

Figure 30. Caves in Greenbrier County, West Virginia (Davies 1965).

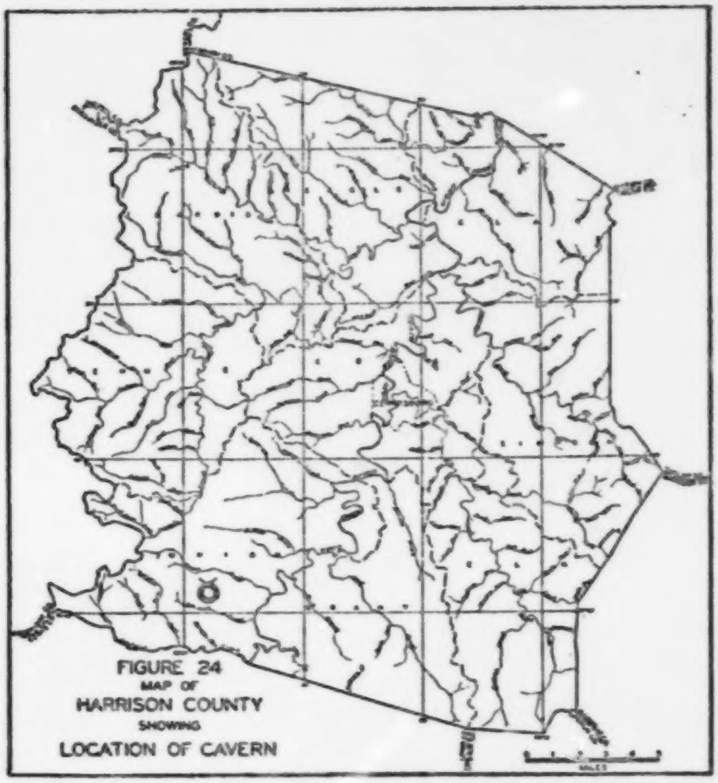
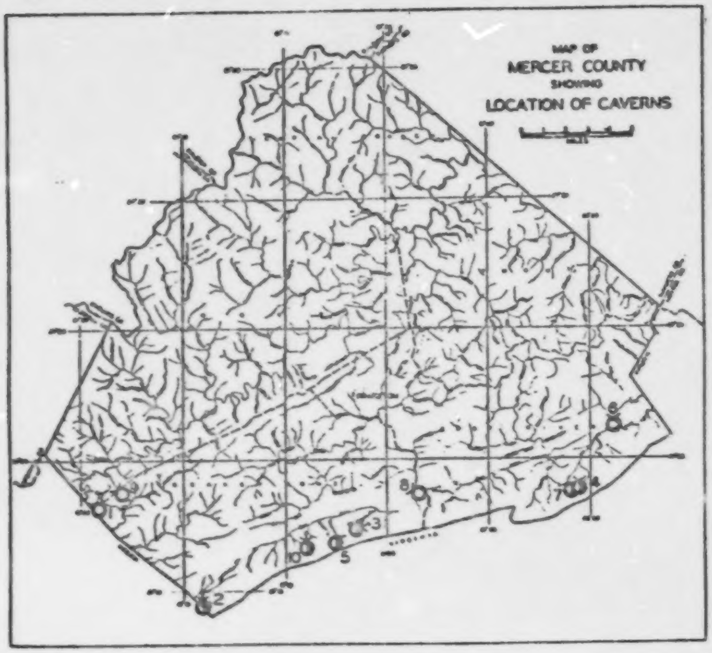


FIGURE 24
MAP OF
HARRISON COUNTY
SHOWING
LOCATION OF CAVERN
MILES

Figure 31. Cave in Harrison County, West Virginia (Davies 1965).


MAP OF
MERCER COUNTY
SHOWING
LOCATION OF CAVERNS
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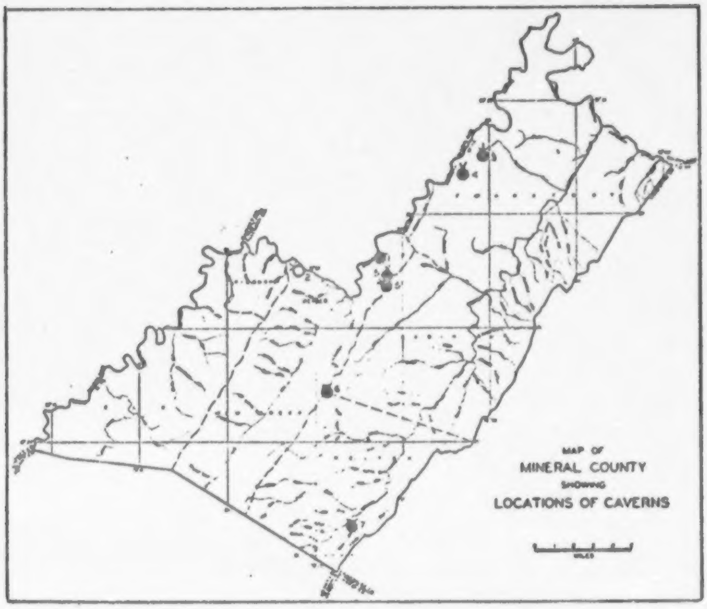
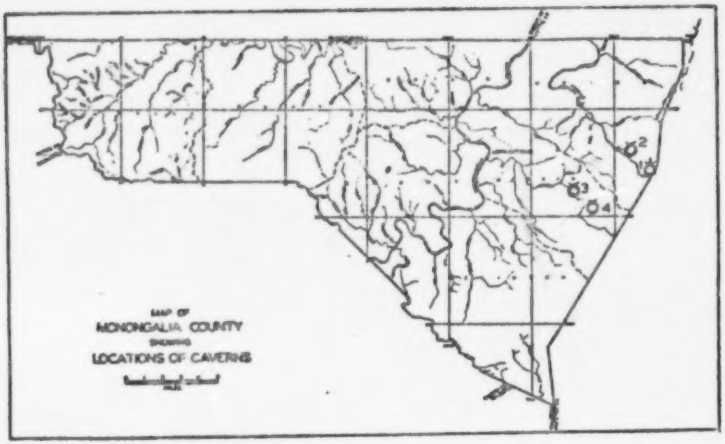
1. Abbs Valley.
2. Beaver Pond.
3. Big Spring.
4. Caldwell.
5. Dyepot.
6. Hales Gap.
7. Honacker.
8. Ingleside.
9. Nemours.
10. Thompson School.

Figure 32. Caves in Mercer County, West Virginia (Davies 1965).


MAP OF
MINERAL COUNTY
SHOWING
LOCATIONS OF CAVERNS
MILES

1. High Rocks Fissure.
2. Kites (Flaherty).
3. Knobly Mountain.
4. Knobly Mountain Vertical Shaft.
5. O'Nell Gap Pits.
6. Ridgeville.
7. Saltpeter.

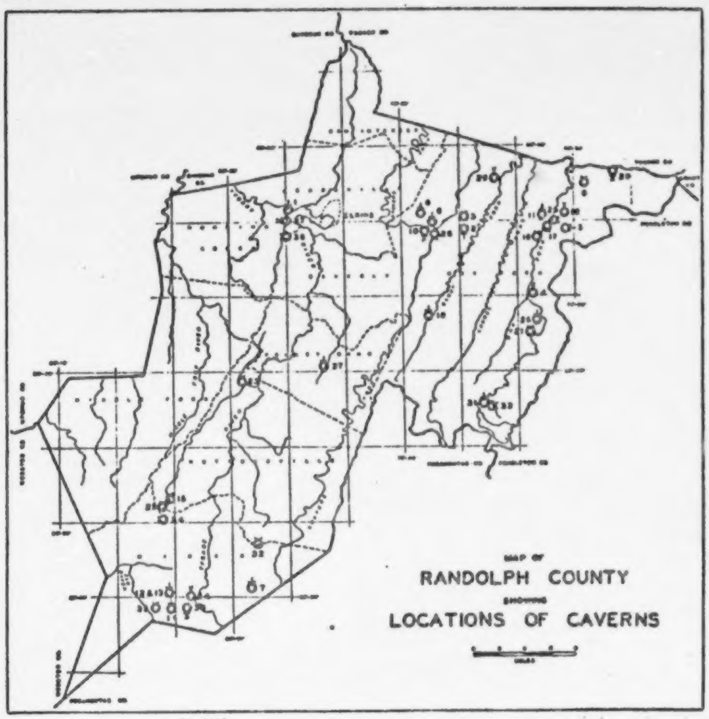
Figure 33. Caves in Mineral County, West Virginia (Davies 1965).



MAP OF
MONONGALIA COUNTY
SHOWING
LOCATIONS OF CAVERNS
2
3
4

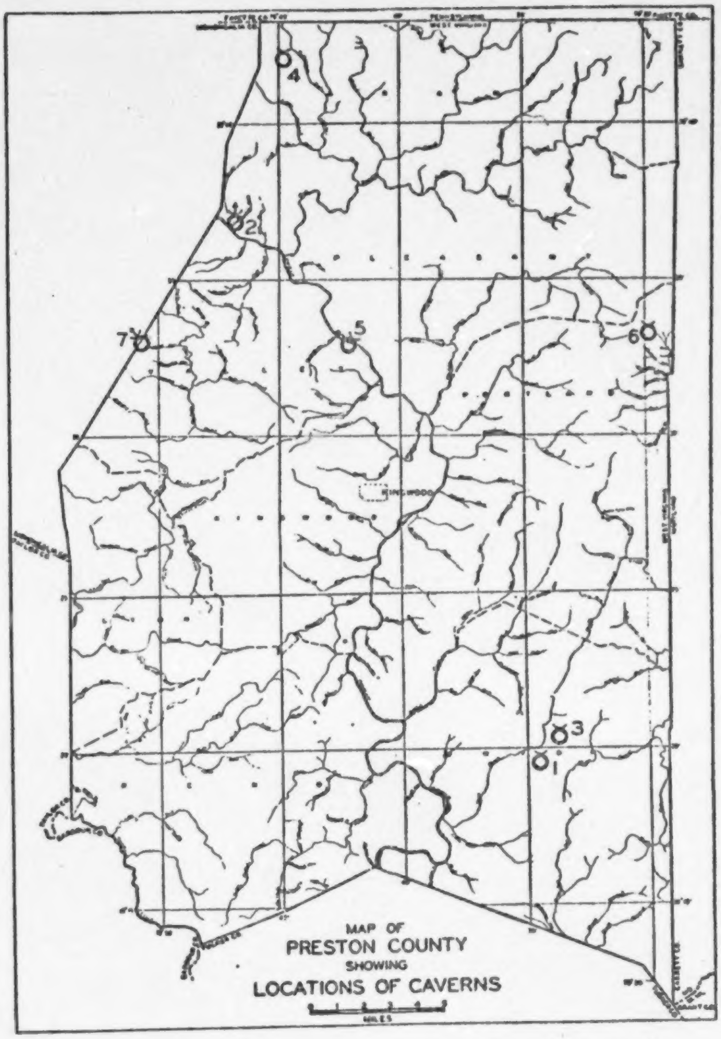
1. Beaverhole Lower (Eagle).
2. Cooper Rock.
3. Dellslow.
4. Maiden Run.

Figure 34. Caves in Monongalia County, West Virginia (Davies 1965).



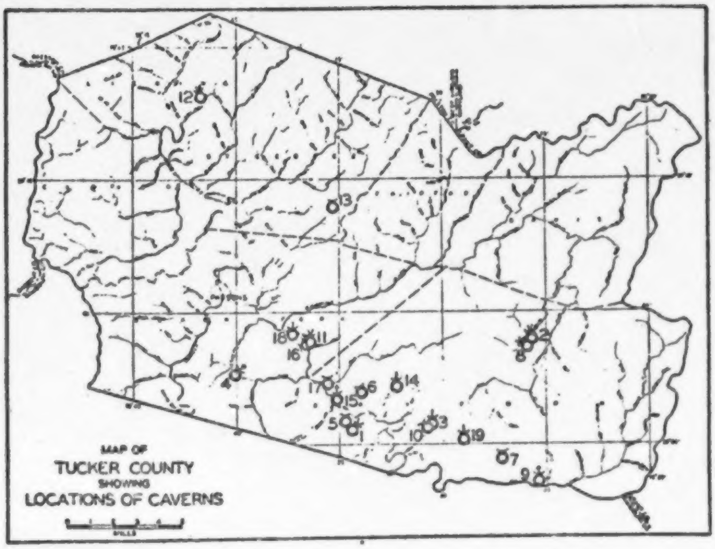
1. Aggregates.
2. Alpena No. 1.
3. Alpena No. 2.
4. Armentrout Pit.
5. Bazzle.
6. Bickle Run (Bear Heaven) Caves.
7. Big Run.
8. Bonner Mountain.
9. Bowden No. 1.
10. Bowden No. 2.
11. Cooper.
12. Crawford (Wymers) No. 1.
13. Crawford No. 2.
14. Falling Spring Cavern.
15. Fortlick.
16. Glady.
17. Harman.
18. Harman Pits.
19. Hazelwood.
20. Jordan Drop.
21. Keyhole (Chalk).
22. Limekiln Run.
23. Mill Creek.
24. Mingo Pit.
25. Nelson.
26. Railroad Caves.
27. Rich Mountain.
28. Rouse.
29. Schmidlen Shafts.
30. Simmons-Mingo.
31. Sinks of Gandy Creek.
32. Stewart Run.
33. Stillhouse (Hermit, Dead Mans).
34. Stony Run.
35. Swacker School.
36. Tyre School.
37. Ward.

Figure 35. Caves in Randolph County, West Virginia (Davies 1965).


4
2
7
5
6
KINGWOOD
3
1
MAP OF
PRESTON COUNTY
SHOWING
LOCATIONS OF CAVERNS
MILES

1. Aurora Cave.
2. Beaverhole, Upper.
3. Brook Stemple.
4. Collins.
5. Cornwell.
6. Cranesville.
7. McKinney.

Figure 36. Caves in Preston County, West Virginia (Davies 1965).


MAP OF
TUCKER COUNTY
SHOWING
LOCATIONS OF CAVERNS
MILES
12
13
18
11
16
4
17
15
6
14
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1
10
3
19
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9
2
8

1. Arbegast.
2. Beall.
3. Bennett.
4. Big Springs (Blowing).
5. Cave Hollow.
6. Falling Spring.
7. Hadey.
8. Harmon Pits.
9. Harr.
10. Lambert.
11. Laurel Run.
12. Limestone Mountain.
13. Maxwell Run Caves.
14. Mill Run.
15. Moore (Red Run Quarry).
16. Otter Creek.
17. Red Run.
18. Stillhouse Hollow.
19. Wolford.

Figure 37. Caves in Tucker County, West Virginia (Davies 1965).

III. US-EPA RESPONSIBILITIES FOR NEW-SOURCE NPDES PERMIT ENVIRONMENTAL REVIEW

Activities That Will Require New-Source NPDES Permits

All coal mines that are initiated on or following the date when new-source standards of performance for the mining industry are proposed by US-EPA in the *Federal Register*, and that plan to discharge water (as point sources) to streams, will be required to obtain NPDES permits and meet National new-source effluent limitations. Issuance of the new-source regulations for the coal mining industry is expected during 1977. Mines which operate prior to the implementation of the new-source regulations are required to apply for existing-source NPDES permits and are subject to existing-source effluent limitations (40 CFR 434; 41 FR 19832, 13 May 1976). New-source effluent limitations are expected to be more stringent than existing-source limitations, and new-source NPDES permits (unlike existing-source NPDES permits) are subject to NEPA review by US-EPA. Notice of US-EPA's intent to issue new-source regulations for the coal mining industry was given in the *Federal Register* on 30 September 1974, and potential new source applicants were encouraged to schedule a pre-application conference with the appropriate Regional Administrator 24 months prior to the expected beginning of discharge. Few West Virginia surface mine operators have contacted US-EPA Region III.

As of March 1977 the new-source regulations were still under review, pending resolution of the definition of activities which would be considered to constitute a new source in the coal mining industry. For surface mining, one issue which will require administrative consideration is whether prospecting applications will be subject to an environmental review as well as actual mining permits. At present there apparently is no mechanism whereby NPDES "prospecting permits" can be converted to "mining permits."

The State of West Virginia considers prospecting to be a significant activity, and consequently requires a detailed plan and a bond for timely reclamation following prospecting activities, should no mining begin within three months of the completion of prospecting. If mining is undertaken, the prospecting bond is applied to the reclamation bond required for the actual surface mining operation. Reclamation is postponed until the completion of mining. The number of prospecting permits issued by the State is substantially smaller than the number of mining permits issued (Table 4); evidently, many mine operators in West Virginia are able to prepare mining plans satisfactory to the State in the absence of on-site prospecting data (or prospect without a permit).

A second issue, which could be of importance for a few years until existing surface mines have been exhausted, is whether new-source requirements will be applied to permitted surface mine acreage that has not yet been mined as of the date of issuance of the regulations. West Virginia, unlike US-EPA, does not issue mining permits for a specified period of time. The rate and duration of mining, consequently, heretofore have been governed largely by economic considerations. It is conceivable that a mine operator might seek a permit with extensive acreage that might require many years to exhaust (given the current price of coal), in order to escape future, more stringent regulations by State or Federal agencies. The major disincentive for such action, apparently, is the expense of the reclamation bond (currently $1,000 per acre, required by the State at the time of application for a surface mining permit. As discussed in a subsequent section, US-EPA could apply non-NEPA coordination requirements to existing sources, and extend a measure of protection to certain resources not currently protected under State law.

NEPA Review of New-Source NPDES Permits

The final regulations for application of NEPA to the new-source NPDES permit program became effective on 10 February 1977 (40 CFR 6; 42 FR 2450-2459; 11 January 1977). According to the regulations, US-EPA intends to apply NEPA substantively to all new-source industrial permits, including the surface coal mining industry. US-EPA requires that a New Source and Environmental Questionnaire (NS/EQ) be submitted by permit applicants and that the entire environmental evaluation process be completed and the NPDES permit issued prior to commencement of on-site "construction".[1]

The Expected Number of New-Source NPDES Permit Applications from the West Virginia Surface Mining Industry

According to the latest annual report of the West Virginia Department of Mines (1975), there were 502 surface mine operations by 278 companies in West Virginia during 1975. The WV-DNR issued 437 permits during 1976, of which 278 were for surface mining and 159 were for prospecting. The 1975 total was 481 permits issued. During each fiscal year from FY 1977 through FY 1980, US-EPA Region III can expect to receive as many as 500 applications for new-source NPDES permits for surface coal mining and prospecting in the State of West Virginia. This number is approximately 100 times as great as the combined number of new-source applications from all other regulated industries in the State (Verbally, Mr. Matthew Miller, US-EPA Region III, 23 February 1977). The mean surface mining permit size during 1975 was 63 acres, and about 20,000 (±10,000) acres will be disturbed annually (Table 5). Recent experience has been that 50 to 60% of State prospecting permits have been converted to surface mining permits.

Approximately 80 to 90% of the mining permit applications are expected to originate from relatively small operations, each of which will mine less than 50 acres of land. In total, these smaller operations annually may extract about 6 million tons of coal (less than one quarter of West Virginia annual surface coal production) and may disrupt the surface over about 7,500 acres.

Larger mines for which applications will be sought may number about 30 to 60 per year. These mining operations generally will propose to extract coal on sites of 100 acres or more. Such mines will disrupt the surface over a total of more than 14,000 acres per year. During 1970 two companies each had secured more than 8% of the total acreage permitted, and the nine largest companies together held about one third of the total acreage permitted for strip mining in West Virginia (Stanford Research Institute 1972:41). Recent large applications have been for 2,000 acres in Webster County, 1,200 acres in Boone County, and 1,200 acres in Raleigh County near Beckley (Verbally, Mr. Roger Hall, Division of Reclamation, WV-DNR, 24 November 1976, and Mr. Patrick Parks, 19 January 1977).

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[1] It is US-EPA policy not to apply NEPA to the issuance of NPDES permits for existing sources (40 CFR 125.43; 39 FR 27084, 24 July 1974). By definition, existing-source permits are issued to operating facilities.

Large surface mines are expected to be most common in the central (Subregion IV) and southern (Subregion V) parts of the State, because abundant reserves occur there, large tracts of land are held in single ownerships, and the steep slopes make top-of-mountain, multiple-seam surface mining operations practical and economic. As stated in Chapter I of this report, the mean acreage of State mining permits in the central and southern part of West Virginia exceeds 100 acres in several counties. Production from individual mines in this area exceeds total production in some of the northern counties, where small mine operations abound.

The conclusion to be drawn from recent State experience is that US-EPA Region III will have a very large number of new-source NPDES permits to process each year, many of which will be for very small surface mines that will operate for three years or less. Consequently, the opportunity for piecemeal decisionmaking is great. As documented in Chapter II of this report, there are numerous environmentally sensitive resources throughout the surface mining regions of West Virginia. There has been extensive damage to these resources in the past, and the potential for future environmental damage from new-source mining activities is great in the absence of regulatory overview (Stanford Research Institute 1972). It is the understanding of the consultant that US-EPA Region III lacks the resources routinely to conduct comprehensive environmental reviews for 500 West Virginia surface coal industry permit applications annually, and therefore must concentrate its resources on those applications which are most likely to generate adverse effects (By telephone, Mr. Peter Cook, US-EPA Office of Federal Activities, Washington DC, 3 February 1977). The following section, therefore, discusses screening procedures for selecting applications to receive comprehensive NEPA review.

Methods to Screen Surface Mining Applications

Every applicant for a new-source surface coal mining NPDES permit will be required to file the NS/EQ as part of his application to US-EPA. The current NS/EQ used by US-EPA Region III is outlined in the Appendix of this report, and is discussed in the subsequent section on Information Required from Applicants.

The US-EPA general new-source NPDES environmental regulations published on 11 January 1977 indicated that it was not considered feasible to establish a threshold defining minor Federal NPDES permit actions which will not significantly affect the environment (comment on 40 CFR 6.904, 42 FR 2451), so every permit application will have to undergo a NEPA review which culminates in either a negative declaration notice (accompanied by an Environmental Appraisal file report) or a notice of intent to prepare a formal EIS (40 CFR 6.904, 6.906, 6.908) unless the regulations are amended. No permit can be issued until such environmental review is complete, and a specified period has elapsed after Federal Register publication of the negative declaration or filing of the final EIS with the CEQ (40 CFR 6.909.2., 42 FR 2455).

As regulations are developed for the coal mining industry, however, it has come to be regarded as feasible to exempt small surface coal mining applications from a formal NEPA review (By telephone, Mr. Peter Cook, US-EPA Office of Federal Activities, Washington DC, 3 February 1977). The draft US-EPA policy on the application of NEPA to new-source coal mines suggests that thresholds be established, based on estimated average annual tonnage coal production, to govern the routine application of NEPA by US-EPA to NPDES permit applications from the industry (Draft memorandum, R. W. Hanmer, Director, Office of Federal Activities, Washington DC, to Regional Administrators, 16 February 1977). Regional Administrators are encouraged to develop additional screening criteria, based on environmental conditions, to identify mines smaller than the National threshold tonnage which should be subjected to a more detailed review. Thus it may become important that US-EPA Region III establish a partial environmental screening procedure whereby certain applications of a size smaller than the Nationally recommended threshold are subjected to environmental review.

Several feasible methods to select projects for environmental review can be envisioned. The method selected and the nature of the surface mining applications singled out for environmental scrutiny will be of great concern, not only to parties concerned with environmental protection, but also to the surface coal mining industry. Negative declarations[1] are subject to challenge by the public, and the full EIS procedure may delay significantly the issuance of a surface mining permit. At present the time span from submission of a State surface mining application to the start of mining operations is generally no more than three months; the full Federal EIS procedure may require one to several years.

The US-EPA Office of Federal Activities has drafted a threshold based on projected average annual tonnage of coal production as a guideline for Regional Administrators. Applications that propose to mine less than 100,000 tons of coal annually are to be exempted from routine NEPA reviews; applications that propose to mine between 100,000 and 200,000 tons are to receive NEPA reviews only if the operators do not certify that they plan to employ "Best Practices" (these practices have not yet been defined); and applications to mine more than 200,000 tons annually routinely are to receive full NEPA review, whether or not the "Best Practices" initially were certified by applicants. The tonnages are based on average proposed production over the life of the NPDES permit (a maximum period of five years).

If such an approach should be adopted for the West Virginia surface mining industry, several results may be expected by US-EPA. The strong probability is that no application for more than 200,000 tons per year will be made to US-EPA Region III. Very large mines are not necessary in West Virginia to provide economic justification for major expansion in infrastructure

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[1] A "negative declaration" is a public notice that the Regional Administrator has decided not to prepare an EIS on a permit. By determining that an EIS is not necessary, the US-EPA concludes that there will not be significant adverse impacts or that significant adverse impacts will be mitigated satisfactorily (42 FR 2451, 11 January 1977).

(railroads, etc.), as is common in the western States. Indeed, the permit applications mainly will originate from small operators in any case. It is impossible to predict how the industry may react to as-yet undefined "Best Practices," but if the regulations withstand challenge, the intermediate-size mines probably will certify "Best Practices" routinely in order to escape detailed NEPA review. (The more Best Practices resemble State preplanning and reclamation requirements, the more likely will be their routine acceptance by the mining industry).

A rapid investigation of the relation between tons of coal produced and permitted acreage in West Virginia was made for this report, but no correlation was observed. This ratio varies significantly across the State. The WV-DNR traditionally has been concerned with acreage, not tonnage or duration of mining, during review of permit applications, and West Virginia mine operators have never been required to provide anticipated production data. A brief examination of summary production data for the 1970's indicated that substantial fluctuations in annual production were typical of individual West Virginia surface coal mines.

It does not appear to be optimal to undertake a detailed NEPA environmental review of a mine several years after it begins operations, if, for example, US-EPA enforcement personnel should discover that the mine's annual production suddenly increased from 80,000 to 300,000 tons, and it therefore qualified for a higher category. If mine operators, on the other hand, are not allowed to respond to the traditionally fluctuating market for coal by increasing or decreasing their production rapidly, it is conceivable that economic dislocation could result. Small-mine operators who are speculating or recovering coal profitably from seams that may pinch out irregularly probably cannot estimate their tonnage accurately, particularly if they have not conducted substantial on-site exploration and prospecting. US-EPA considered but rejected tonnage as a criterion for applying its effluent guidelines, "because it was not found to be a valid indicator of pollution" (41 FR 19839, 13 May 1976). Finally, non-NEPA environmental coordination must be completed prior to permit issuance in any case, whatever the tonnage production.

An exemption for small mines potentially even more serious than the detailed NEPA environmental review is their proposed exemption also from Federal Best Practices requirements (Draft memorandum, Hanmer to Regional Administrators, 16 February 1977). Best Practices guidelines were in an early draft form as this report went to press, so it was difficult to estimate what effect the guidelines eventually may have on either the surface mining industry or the environment. The State of West Virginia, however, makes no distinction between mines on the basis of size when it requires preplanning for mining and reclamation. Part of the US-EPA rationale for the proposed exemption of small mines from routine, detailed NEPA review was the supposed equivalence of pollution control that is to be achieved by large and small mines. It is not clear, however, that the assumption of equivalence is appropriate, if small mines are held to less stringent requirements than large mines.

A preliminary screen might gauge potential environmental effects prior to full NEPA review based on the extent of proposed acreage that is to be disturbed. A threshold exemption from review or requirements based on acreage could serve to keep the acreage of each permit small, which in itself might augment paperwork without increasing environmental protection. Like tonnage, an acreage screen in itself does nothing to weigh the actual environment in which the disturbance is to take place. Previously surface-mined areas that were abandoned without reclamation generally are benefited environmentally by mining under current State environmental and reclamation standards, according to the WV-DNR, and State policy therefore is to encourage the maximum amount of acreage re-mined. Acreage disturbed may be a useful first approximation, however, to the potential adverse impacts of surface mines on previously unmined land, even though water quality impacts are not readily inferred from mine acreage in the absence of data on mining methods. According to a recent draft US-EPA manual for the review of mining-related EIS documents, "methods of mining and handling the overburden are major factors influencing sediment yield rather than the size of the operation" (US-EPA 1976b:43).

Yet another way to screen applications might be by a randomized selection procedure. When US-EPA Region III knows its resources and the number of environmental reviews it reasonably can conduct during the fiscal year, it could select, say, every twentieth or fiftieth application for a detailed review. If every applicant were aware that he was subject to a possible detailed environmental review, the industry might respond by providing more thorough internal planning for alternatives that minimize adverse effects than if almost all applications were subject to virtually no scrutiny by US-EPA Region III. If the probability of US-EPA environmental review were low enough, however, sound business judgment might opt to minimize concern for environmental aspects of the proposed mine that are not otherwise covered by State regulations, because of the low risk of permit delay.

A third way to screen projects rapidly to ascertain the need for more comprehensive environmental review is the development of a geographically based inventory of known sensitive resources. Within the areas known to have sensitive resources that must be considered under NEPA according to 40 CFR 6.910 (42 FR 2455) or that involve coordination with other agencies according to 40 CFR 6.920 (42 FR 2456), a comprehensive review probably will be in order even if the application is for a small surface mine. Outside such areas, small mines reasonably could be issued permits in the absence of environmental scrutiny, so long as they do not generate public controversy or the opposition of other agencies. For the West Virginia surface mining industry such an inventory would have to be prepared in sufficient local detail to enable the precise placement of surface mines as small as three acres (Table 5). Data on certain parameters, such as the presence of archaeological resources on a mine site, probably will not be available until the results of professional site surveys are provided by an applicant. (Existing statutes and regulations apparently require that archaeological resources must be protected through coordination, whether or not a NEPA review is performed, prior to NPDES permit issuance; but the requirements have not been enforced for existing-source permits).

Alternative Types of Impact Statements and Environmental Review

Several options are available to US-EPA Region III concerning the overall environmental assessment of its proposed NPDES permit program for the surface coal mining industry in West Virginia. The following sections discuss alternative approaches to fulfillment of agency responsibilities under NEPA.

Program and Generic Impact Statements

In guidelines issued by the Council on Environmental Quality on 1 August 1973 (40 CFR 1500.6.f.1., 38 FR 20550), the use of program and generic impact statements is encouraged. These comprehensive EISs cover a number of related individual actions, and are intended to be more useful and efficient than would be separate analyses of the various individual actions.

Program statements that are sufficiently comprehensive and informative and that present a suitable regulatory strategy which insures individual project review, will eliminate or minimize the need for EISs on individual projects. Thus, these statements can reduce redundancy, eliminate unnecessary paperwork, and thereby make the environmental review process more meaningful and productive. A separate, more detailed NEPA review and possibly an EIS will be required, however, for a proposed action that has the potential for significant environmental impacts which are not covered adequately in the program statement (CEQ 1973a).

The specific wording of the CEQ Guidelines for program statements is:

> Agencies should give careful attention to identifying and defining the purpose and scope of the action which would most appropriately serve as the subject of the statement. In many cases, broad program statements will be required in order to assess the environmental effects of a number of individual actions on a given geographical area (e.g. coal leases), or environmental impacts that are generic or common to a series of agency actions (e.g., maintenance or waste handling practices), or the overall impact of a large-scale program or chain of contemplated projects (e.g., major lengths of highway as opposed to small segments). Subsequent statements on major individual actions will be necessary where such actions have significant environmental impacts not adequately evaluated in the program statement.

This approach was reaffirmed by the Supreme Court during 1976 in the Northern Great Plains case, Kleppe versus Sierra Club (CEQ 1976).

Areawide Impact Statements

Comprehensive EISs are known as program statements, generic statements, or by other names. The term, "areawide statement," has been adopted by US-EPA to describe comprehensive EIS's to be prepared for anticipated multiple permit actions in specific geographic areas.

Section 6.910.a.2 of the US-EPA guidelines (42 FR 2455, 11 January 1977) suggests that program statements also may be required to assess the cumulative impacts of a number of minor actions within a given geographic area:

> If EPA is proposing to issue a number of minor, environmentally insignificant new source NPDES permits, during a limited time span and in the same general geographic area, the responsible official may determine that the cumulative impact of the issuance of all these permits may have a significant environmental effect.

An areawide EIS, thus, may be prepared to consider two or more relatively major actions proposed for implementation in a region, or it may cover the cumulative impact of a number of individually minor actions, or it may include both minor and major actions. The validity and the scope of the program statement, or areawide EIS, should be based on geographical proximity of the project sites and on the degree of interdependence of the actions or their environmental effects.

The Supreme Court reaffirmed this responsibility in Kleppe versus Sierra Club:

> [W]hen several proposals for coal-related actions that will have cumulative or synergistic environmental impact upon a region are pending concurrently before an agency, their environmental consequences must be considered together (CEQ 1976:7).

In regard to the issuance of permits for surface mining in West Virginia, the consideration of projects that will be located within a particular watershed , drainage area, or river basin would satisfy both the proximity test and the cumulative impacts test. US-EPA already has indicated that the "most effective way to comply with NEPA on new source coal mine permits is to assess new coal mining activity on an areawide basis" (41 FR 19840, 13 May 1976).

To expedite the process of environmental review under NEPA, US-EPA Region III may opt to issue one or more areawide "umbrella" EISs for the surface coal mining sections of West Virginia to identify the probable effects of issuing an undetermined number of new source NPDES permits to the surface coal mining industry, in advance of receipt of the specific applications. Such EISs could present inventories that define sensitive areas.

A major concern will be the effects of the permit granting action on water quality. Presumably US-EPA would specify that new-source permit applicants are required to demonstrate their ability to meet US-EPA discharge standards and to satisfy State water quality standards by various technological means and by carrying out self-monitoring and self-reporting requirements. The US-EPA presumably would have to present a regulatory strategy based on the ability of West Virginia streams to accept surface mine wastewater. Such a strategy could involve a method for the identification of surface mine wasteload-accepting capacity of the many streams that potentially will receive surface mine wastes. The US-EPA could require that applicants prevent the discharge of any additional pollutants to streams that had reached their safe mine-waste assimilating capacities. On streams where the natural waste-accepting capacity was rated as nil, or where significant environmentally sensitive resources could be affected downstream, new source mining could be prohibited unless the applicant could demonstrate no adverse impact, adequate mitigation, and/or overriding public need in a full individual-mine EIS. Where the natural assimilative capacity already was exceeded because of existing mine wastes or other pollution, new sources of surface mining wastes that could not achieve "no additional pollutants" discharges would be prohibited, at least until the existing pollution was terminated and the assimilative capacity of the stream was deemed adequate to accept the proposed new-source discharge without significant adverse effects. Presumably US-EPA could pattern its wastewater discharge control strategy after its current "tradeoff" strategy to control airborne emissions under the Clean Air Act.

A practical difficulty in the implementation of full areawide EIS procedures will be the absence of precise information on the number of new sources, their location, and the time period during which each will operate and produce discharges. Information on location and timing of proposed discharges would be critical, for example, in determining the severity or insignificance of cumulative impacts due to concurrent surface-mine discharges into a waterway. It probably is feasible to develop realistic models for mine-affected water-quality parameters, but data sufficient to calibrate the models for West Virginia streams currently do not exist (By telephone, Mr. A. Maniktala, WV-DNR, 31 January 1977). To collect essential field data and model every stream potentially affected by surface mining in West Virginia would be a major effort. US-EPA Region III may have to stage any efforts in this direction carefully to provide assessment data for streams in the sequence that they are to be affected by proposed surface mines. This analytical effort should be coordinated closely with any similar work related to the underground mining NPDES program in West Virginia, which is outside the purview of this report. If the thrust of the US-EPA effort is to generate useful regulatory models for West Virginia streams, each applicant then can be expected to provide data sufficient to calibrate the appropriate model locally for his minor watershed under existing and forecast conditions at the time of his permit application.

There are substantial potential problems that must be considered by US-EPA, if a NEPA approach to water quality management resembling that outlined in the preceding paragraphs were implemented. First, US-EPA will have to consider the resources which it can allocate to a comprehensive inventory effort and supportive recordkeeping.

The effectiveness of the approach also depends upon the vigorous enforcement of standards and monitoring requirements. Historically the Executive Branch of the State of West Virginia devoted little effort to the actual enforcement of legislatively mandated controls over the surface mining industry (Stanford Research Institute 1972: 104ff.), but recent State enforcement within the limits of the State regulatory mandate has been increasingly effective (numbers of successful prosecutions were presented in Table 4). US-EPA, like the State, will be faced with inspecting hundreds of remote, permitted mining operations scattered over 29 counties with a total area of thousands of square miles of rugged terrain. Second, US-EPA has not promulgated regulations to cover the long-term effects of surface mining on water quality. Interim final existing point-source coal mining discharge regulations specifically cease to apply to mines when regrading (but not revegetation) has been accomplished (40 CFR 1.434.32; 41 FR 19835, 13 May 1976). No mention is made of any requirement to bury or otherwise isolate toxic or acid-producing overburden when the mine is "returned to final contour," or to continue the maintenance of surface drainage installations which may be necessary to divert runoff from the regraded spoil. Presumably requirements of this nature will be part of the forthcoming "Best Practices" regulations, but as presently conceived, those regulations will not apply to 80% of West Virginia NPDES mining applications too small to meet the Nationally based tonnage threshold.

In West Virginia, surface ownership typically is separate from mineral ownership, and the question of who has responsibility for maintenance of drainage installations after mining ceases is complex (WV-DNR 1975a). The State of West Virginia ordinarily releases 75% of a reclamation bond at the time regrading is inspected and found complete. The remaining 25% cannot be released until inspection following the close of the second growing season after replanting of vegetation. US-EPA is considering extending mine operators' liability for a longer period, but as presently conceived, these regulations will not apply to at least 80% of West Virginia mining applications, unless Region III adopts more stringent criteria than the National "Best Practices" guidelines.

Alternatively, permits routinely could be conditioned so as to require the applicant to provide 95% confidence that the risk of sheet erosion from a regraded mine site would be no more than the maximum rate associated with severe storms on comparable unmined areas, or ten times the typical annual rate locally on unmined areas, whichever is less (Stanford Research Institute 1972:147). Such a provision might be difficult to implement during the period after mining has ceased and the 5-year maximum NPDES permit presumably has expired. The potential for adverse water quality impacts, however, does not decline substantially until a permanent canopy of long-lived vegetation has been established. Typically this process requires decades in West Virginia. This situation is one that makes surface mining quite different from industries in which, when production stops, discharges also cease.

The techniques of assuring revegetation of regraded mine spoil are still in the stage of development. Unless surface mined land is returned to timber production or placed in other beneficial use, it can become a future source of sediments and acid wastes. West Virginia State reclamation funds can be used only for old, orphaned mine sites; they cannot be used for sites reclaimed and released from bond, even if subsequent denudation should occur on those sites subsequent to bond release.

Environmental assessments (or EISs) prepared in compliance with NEPA must address all categories of environmental components, not just water quality. US-EPA therefore presumably will have to present a strategy whereby potential adverse effects of surface coal mining on the various non-aquatic environmental resources also will be minimized or avoided. One means of accomplishing this goal would be to present a detailed inventory of known sensitive components in each watershed. Prospective applicants could be warned that applications which are found upon review to be likely to affect known sensitive areas will be subjected to full individual mine NEPA scrutiny. An obvious incentive thereby would be created for applicants to seek out sites that can undergo a cursory environmental screening. Certain resources are amenable to areawide inventory by US-EPA or its consultants, such as, for example, vegetation types, stream water quality, State parks, and surface reservoirs used for drinking water supply. Other resources may not be amenable to areawide inventory because of the considerable effort and expense involved; for example, historic, archaeologic, and architectural resources. Such resources may be best identified by applicants through specific professional surveys of individual sites proposed for mining. US-EPA Region III could review critically all aspects of the proposed mining engineering, because these already must be presented in each State mining application, if it were concerned with the engineering design aspects of the NPDES permit applications and had sufficient resources to secure engineering expertise in-house or through consultants.

Those applications for new surface coal mine NPDES permits which demonstrate (1) a capability to meet applicable discharge standards, (2) a stream that acceptably can assimilate discharged wastewater of the proposed quality, (3) an acceptable plan to minimize long-term adverse effects on water quality and the means to effectuate such a plan, (4) an avoidance of environmentally sensitive areas, (5) a conscientious review of potential site-specific resources in consultation with appropriate agency personnel, and (6) a sound engineering plan for the proposed mining activity, presumably will be processed expeditiously, and insofar as possible through US-EPA reviews that eventuate in negative declarations (or comparable public disclosure), rather than by a full EIS procedure, whatever their anticipated production tonnage. Environmentally sound aspects of proposals can be included as obligatory permit conditions, along with the appropriate recommendations of agency review personnel. An areawide program EIS could propose a procedure for expediting the issuance of permits to mines which meet these criteria.

Should US-EPA Region III decide not to issue one or more formal areawide EISs on its intent to implement the West Virginia surface coal mining NPDES permit program, it nevertheless may consider the preparation of areawide inventories and reviews. At minimum such an effort would expedite the processing of NPDES permit applications. Should US-EPA be challenged successfully for not producing EISs on its regulatory program for the West Virginia surface mining industry, the areawide assessments would facilitate the timely completion of draft EISs. Preparation of in-house areawide environmental reviews presumably would not stop the issuance of permits to the industry, as a formal notice of intent to prepare areawide EISs presumably would do (except for permits that were covered by individual-mine EISs) in accordance with 40 CFR 6.909.a (42 FR 2455, 11 January 1977).

Individual-Mine Approach (Third-Party Agreements)

To conserve its resources, US-EPA Region III may encourage development of the EIS by a third party, as provided in 40 CFR 6.908.e, when the determination to prepare an individual-mine EIS has been made. A third-party agreement is an optional arrangement that can be initiated at the request of either the responsible US-EPA official or the applicant, and requires the mutual agreement of both parties. The decision to enter into a third party arrangement should be made prior to the submission of an applicant's environmental impact assessment (EIA) to US-EPA. The EIA essentially is incorporated into the EIS, and is not prepared as a separate document. The third-party arrangement is not to be implemented until a notice of intent to prepare an EIS has been published by US-EPA. The applicant retains the services of a third-party consultant. The responsible US-EPA official must approve the third-party consultant based on the consultant's objectivity and financial independence from the applicant. The responsible US-EPA official has the authority to specify the type of information that is to be developed. He is responsible for supervising the gathering of the minimum necessary information, its analysis, and its presentation in the EIS. The responsible US-EPA official also must provide the applicant a sufficient opportunity to review the draft and final EIS documents prior to their publication.

Third-party agreements are intended to expedite the preparation of the EIS and to economize on the human effort required in the preparation of an EIS. EPA benefits by its access to the services of a consultant, and applicants benefit by reducing the time required to finalize their applications.

Under an individual-mine approach, US-EPA and the applicant, possibly assisted by consultants, must agree upon the area to be assessed in each environmental assessment report. It is probable that the impact assessment area will have to be larger, at least for selected information requirements, than the actual site of the mine itself and the adjacent land within 1,000 feet, which is described in the permit applications that currently are required by the West Virginia Department of Natural Resources (WV-DNR).

It has long been the policy of WV-DNR to consider each surface mining permit in isolation from others, so the enlarged geographical, as well as substantive, context required by US-EPA for NEPA review will represent an expansion of analysis and increased costs for prospective mine operators. US-EPA Region III specifically will have to adopt a broad framework of reference when issuing NPDES permits for new-source surface coal mines, and take cognizance of nearby mining activity in the watershed:

> To prevent piecemeal decisionmaking, the new source should be described in as broad a context as necessary. The relationship of the proposed new source project to other projects and proposals directly affected by or stemming from the construction and the operation of the new source shall be discussed ... (40 CFR 6.924.c.1; 42 FR 2457).

As previously indicated, it is probable that forthcoming US-EPA Nationwide guidelines for tonnage exemptions of small surface mines from routine, detailed NEPA review and from "Best Practices" will mean that few, if any, West Virginia new source surface coal mines will be subject to detailed review, much less to EISs, unless Region III adopts more stringent criteria or there are successful legal challenges. Therefore, no substantive determination of significant adverse or beneficial impact will be made, and no negative declaration or EIS will be prepared. It is impossible to estimate the number of permit applications which US-EPA Region III may be forced to review in detail under NEPA because of public controversy. Likewise uncertain is whether the threshold exemption policy for small surface mines will withstand court review, should it be challenged. Presumably any such exemption of new source mining applications from NEPA review will have no effect on coordination requirements for environmental review under Federal laws independent of NEPA, as discussed in a subsequent section of this report.

Delineation of Study Areas

Should US-EPA Region III adopt an areawide approach to environmental reviews of applications or to EISs, it will have to delineate the regional study areas. These areas should be selected to maximize the probability that adequate assessments can be prepared efficiently. Alternatives for this regionalization discussed here include political units, coal regions, and watersheds.

Political Unit Basis

There are two prime categories of political units which might be considered for areawide assessment or EIS purposes. One is the State of West Virginia as a whole. The other is the individual counties or groups of counties. To assess adequately the effects of surface coal mining throughout the State, a great deal of information must be assembled and analyzed, and relatively few of these data are preserved by the WV-DNR.

For some regions there is more information than for others, so action in some regions could be delayed while EIS preparation was completed for the last remaining areas, should US-EPA be compelled to elect to follow the EIS route. If the level of detail were not adequate throughout the State, it is likely that a court challenge could force supplementary analyses of specific areas, with substantial attendant delay before permits could be issued, at least in those areas.

> [I]n Natural Resources Defense Council v. Morton, ... plaintiffs sought successfully to compel the Bureau of Land Management to prepare 'geographically individualized' impact statements on the grazing program under the Taylor Grazing Act even though BLM was preparing an EIS on the entire grazing program. The court held that substantial issues related to specific areas should be dealt with in subsequent environmental impact statements (CEQ 1975:646).

A regionalization by county or groups of counties could overcome some of the foregoing potential difficulties. There is, however, no current regulation of coal mines at the county level other than the State moratorium prohibition on mining in 22 counties (of which only 7 have potentially strippable coal resources), and there is not ongoing collection of environmental information on this level. (Census, mining production, and employment statistics, however, generally are available by county.) The boundaries of the 29 surface coal producing counties correspond only in part with major drainage basins, although the effects of surface mining are cumulated primarily within the drainage basins.

Counties were grouped into eleven planning and development regions by the West Virginia legislature during 1971 (Figure 38). Regions consist of from two to eight counties. Only Region 7 consists entirely of surface coal producing counties. Regions 5, 9, and 10 currently produce no surface-mined coal; all of the remaining regions contain both counties which do and counties which do not produce surface-mined coal. Like the counties themselves, these regions do not strictly correspond to major watersheds.

Surface Coal Mining Regions

One regionalization of West Virginia "surface mining provinces" was made by Smith and others (1974) on the basis of geological characteristics. Mine drainage and water quality are influenced by the characteristics of the overburden. Three provinces were delineated in the State (Figure 39). These provinces are rather large to serve as areas for environmental analysis on surface mining, and they cut acress major river basins.

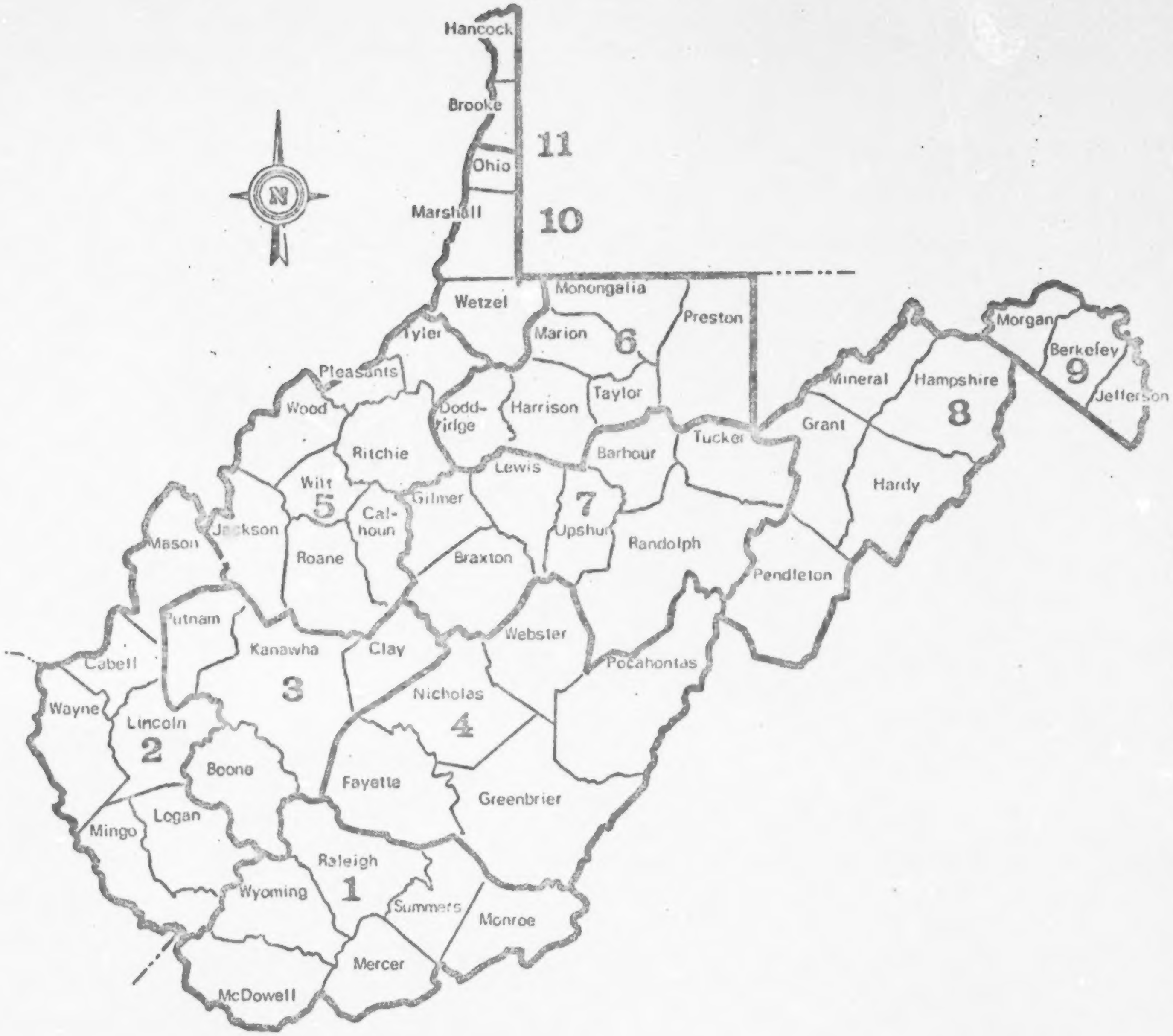
N
Hancock
Brooke
Ohio
Marshall
11
10
Wetzel
Monongalia
Preston
Tyler
Marion
6
Taylor
Pleasants
Wood
Doddridge
Harrison
Ritchie
Barbour
Tucker
Wirt
5
Calhoun
Gilmer
Lewis
7
Upshur
Randolph
Jackson
Mason
Roane
Braxton
Putnam
Kanawha
Clay
Webster
Pocahontas
Cabell
3
Nicholas
4
Wayne
Lincoln
2
Boone
Fayette
Greenbrier
Mingo
Logan
Raleigh
1
Wyoming
Summers
Monroe
Mercer
McDowell
Mineral
Hampshire
Grant
8
Hardy
Pendleton
Morgan
Berkeley
9
Jefferson

Figure 38. West Virginia planning and development regions established pursuant to a 1971 Act of the State Legislature (West Virginia Deparment of Commerce 1976).

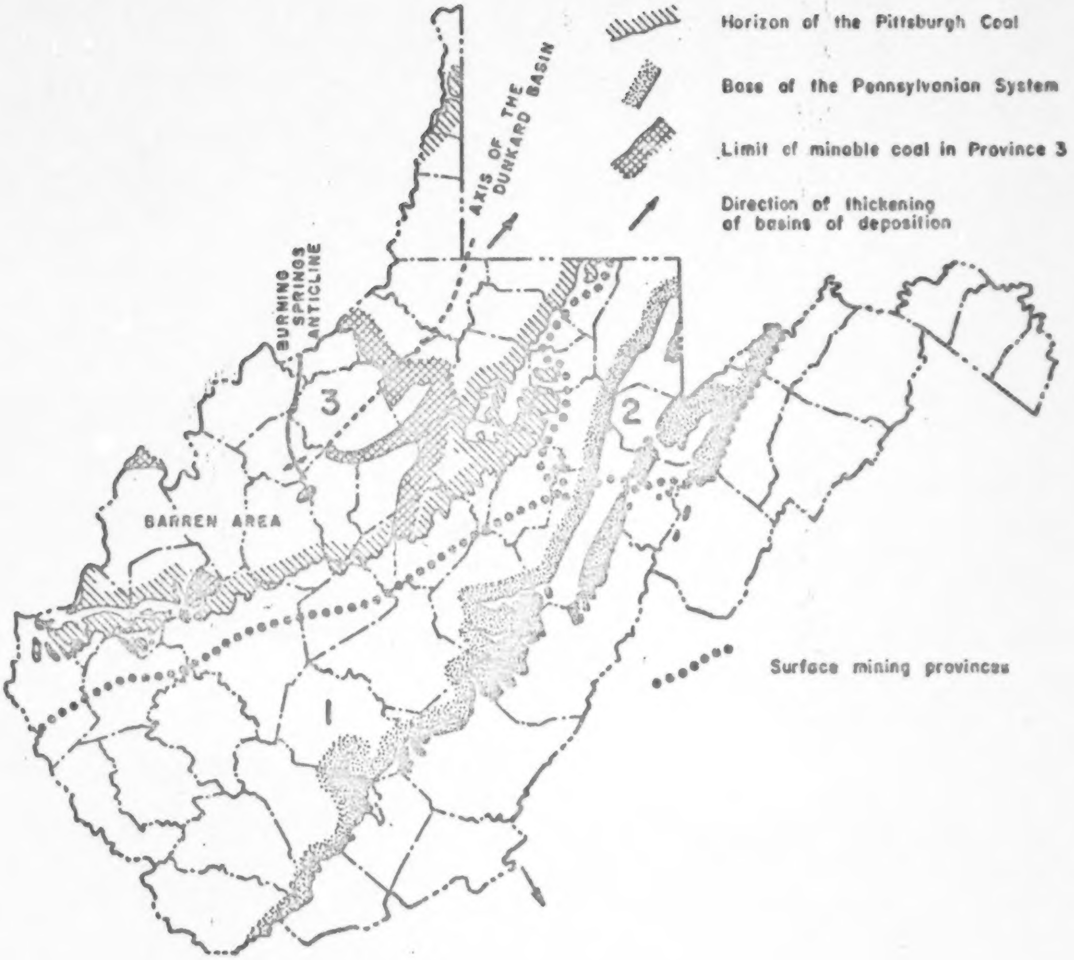
Horizon of the Pittsburgh Coal
Base of the Pennsylvanian System
Limit of minable coal in Province 3
Direction of thickening of basins of deposition
Surface mining provinces
AXIS OF THE DUNKARD BASIN
BURNING SPRINGS ANTICLINE
BARREN AREA
3
2
1

Figure 39. Surface mining provinces of West Virginia based on geological characteristics (Smith et al. 1974).

Surface coal mining subregions were discussed in Chapter I of this report. These are areas of concentrated surface mining activity. Subregions I, II, and III have generally similar coals throughout, but Subregions IV and V include mining of dissimilar coals from one boundary to another. Mining operations within subregions tend to be characteristic: small mines in Subregions I and II; mountaintop operations in Subregion V; a potential for markedly increased mining activity in Subregions III and IV. In Subregion I high sulfur concentrations in coal and in some overburden rocks make acid mine drainage a prime environmental concern; in Subregion V the steep slopes make erosion and sediment the prime general hazards. In Subregions II and IV sandstone overburden presents reclamation difficulties. Subregion III is primarily a little-disturbed natural areas, and its major waterway has essentially no mine-waste assimilation capacity. Subregion III consists of one discrete watershed. The other Subregions can be subdivided internally by major watersheds, as in the Chapter I discussion of their coal resources.

Watersheds

In West Virginia the mountains and drainage systems characteristically extend through several counties. The off-site effects of surface coal mining on stream regimen, water quality, and aquatic biota are cumulative in streams. Several agencies have reported data on the major watersheds of the State: the US Geological Survey, the Army Corps of Engineers, the several interagency committees which prepared comprehensive river basin reports, and the ongoing Statewide river basin planning groups funded by US-EPA under Section 303.e of FWPCA. Thus at least partial data bases are available for use in areawide watershed environmental reviews.

It is reasonable to anticipate regulation of the surface coal mining industry based in part on the capacity of receiving streams to accept point and non-point discharges from the spoil banks, mine pits, and access roads associated with both proposed or active coal mines and abandoned or "reclaimed" inactive mine workings. For this purpose areawide demarcation by major watershed, with subdivision by minor basins, is essential. The watershed basis for areawide assessment is amenable to rational subdivision by subbasin as required by local circumstances, if the need should arise to prepare separate areawide EISs for individual subbasins.

There are fifteen major drainage basins in West Virginia which could be the sites of new-source NPDES permits for surface coal mining. Of these, about twelve will have a substantial amount of permit activity that may require priority attention. The affected basin segments range in size from about 300 square miles to more than 1,500 square miles, with a mean size of about 900 square miles (Figure 37, Table 37), but environmental inventory would be required only for the sections that have surface minable coal reserves.

Table 37. Watershed sections in West Virginia that will be affected by surface coal mining, 1977-1980. An asterisk (*) indicates major subbasins that probably will require priority treatment because of numerous permits. Data on number of active mines from WV-DNR map current during October 1976. Mines and watersheds are depicted in Figure 7.

BASIN	Approximate Size (square miles)	Number of Active Surface Coal Mines
Ohio (tributaries)	500	6
*Potomac (North Branch)	300	23
*Monongahela (Mainstem)	600	27
*Monongahela (West Fork)	900	76
*Tygart	1,400	49
*Cheat	1,400	50
Little Kanawha (upper)	500	5
*Kanawha (Mainstem)	600	37
*Coal	900	42
*New	1,100	21
Bluestone	500	5
*Gauley	1,400	64
*Elk	1,500	15
*Guyandotte	1,000	25
*Tug Fork	700	21
Total	13,300	466

Small mines (less than 100,000 tons/year) were scattered throughout the State during 1975, the latest year for which production data are available. Large mines, more than 100,000 tons/year also were scattered widely, but there were no large mines in the northern panhandle which drains to the Ohio River or in Subregion 11. There were 26 large mines in the Monongahela River basin (including tributaries) and 20 in the Kanawha River basin (including tributaries; data from US Bureau of Mines).

A combination of watersheds and coal subregions probably would constitute the best practical regionalization for areawide assessments of the West Virginia surface mining industry. The actual delineation of areawide assessment regions can be made rationally on the basis of the degree of geographical precision US-EPA can expect to develop. The smaller each region is, the more local detail can be developed, but the greater the potential effort and expense.

Priorities and Timing of EISs

If US-EPA Region III should adopt exclusively an individual-mine EIS approach, rather than an areawide alternative, then the burden of effort in production of information and the pressure for timely completion of analyses would rest almost entirely with the applicant and/or his third-party consultant for those mines that are judged to require EISs. Applicants who can provide timely environmental impact assessment reports (EIAs) or third-party EISs probably would not be delayed by grouping with other applicants into areawide EIS procedures, and US-EPA Region III could process applications in the order received, rather than having to designate its own regional priorities among areawide EISs.

If US-EPA Region III should adopt an areawide EIS approach and undertake the preparation of five, ten, or twelve drainage-basin areawide EISs, it then must determine which EISs are to be issued first, in the event that it is not feasible administratively to process them all simultaneously. The same need for priorities probably would obtain if the areawide environmental assessment option is selected, but presumably such an option would not terminate issuance of permits in the same way that a notice of intent to prepare EISs would. Applications for permits probably would be encouraged during the short run in those watersheds for which areawide EISs are issued first.

An additional influence on the timing of permit issuance under the new-source NPDES program is the potential for court challenge of the EISs. If an areawide EIS were challenged successfully, numerous permits presumably would be affected, whereas only one permit would be affected under any single challenge, given an individual-mine EIS approach.

Individual surface coal mine EISs from an area being covered in an areawide EIS could be issued during the period of preparation of the areawide EIS. This procedure was approved by the Supreme Court during 1976 in Kleppe versus Sierra Club:

> [W]hen approval of one proposal or action is independent of other proposed actions to be covered in a comprehensive impact statement -- the single action may proceed before the final comprehensive EIS is complete if an impact statement is prepared on the single action and its effects are analyzed cumulatively, along with the likely effects of the other actions, in the comprehensive statement (CEQ 1976:11).

Large surface-mine operators typically hold more acreage under permit at any one time than small operators, and therefore have a longer period of operation during which they can mine in the absence of new permits than small operators. As of 1970, most companies held about one year's minable acreage under permit in advance of mining operations (Stanford Research Institute 1972:41).

Cost of EIS and Assessment Preparation

To maximize its capability to assure that environmental quality is maximized in compliance with NEPA and FWPCA, US-EPA may attempt to shift the costs of environmental review onto applicants to the maximum extent possible. US-EPA apparently lacks the statutory authority to recover administrative costs from applicants for NPDES permits (Verbally, Mr. Peter Cook, Office of Federal Activities, US-EPA, 15 February 1977). For this reason, US-EPA recently adopted the procedure for third-party agreements, as described in a previous section.

It is probable that third-party agreements for areawide environmental assessments or for areawide EISs virtually will be precluded, because numerous competing mine operators of different sizes will be affected. There consequently will be no opportunity for US-EPA Region III equitably to shift the preponderant fraction of areawide costs onto the applicants. It is important, therefore, that US-EPA concentrate its funds for areawide assessment or EIS preparation on those basins where new surface mining activity will be greatest. In geographical areas where there are only a few, widely scattered new mines, the individual-mine approach may be appropriate through 1980, or until the quantity of permit applications increases.

The assumption of areawide assessment or EIS costs by US-EPA probably will benefit most the numerous small operators in West Virginia, who typically have smaller profit margins than medium and large mining companies (Stanford Research Institute 1972:76). State permit and reclamation requirements already are proportionately more expensive for small mines than for large mines (Stanford Research Institute 1972:63), and the trend during the past decade has been toward larger areas included in each permit (Stanford Research Institute 1972:42). It is reasonable to expect that the environmental information US-EPA will have to require in order to make negative declarations under an areawide procedure, however, will be an additional operating cost for all applicants subjected to full detailed NEPA review and "Best Practices". As discussed in a subsequent section, the first applicant who proposes to mine in a minor watershed may have to bear a disproportionately large share of the cost of environmental analyses for the watershed.

Environmental Review Independent of NEPA

Whether or not an areawide or individual-mine EIS is prepared, or a detailed NEPA environmental review of new-source NPDES permit applications is conducted, there are other Federal requirements for consultation and review of Federal permit actions under laws independent of the National Environmental Policy Act. For the surface coal mining industry in West Virginia, these requirements will include in particular, but not be limited to, the scrutiny of (1) historic, architectural, scientific, and archaeologic resources, (2) wetlands, (3) floodplains, (4) wild and scenic rivers, (5) threatened or endangered species, and (6) agricultural land (40 CFR 6.920; 42 FR 2456-2457, 11 January 1977).[1]

Historic, Archaeological, and Related Resources

The National Historic Preservation Act of 1966, Executive Order 11593, the Archaeological and Historic Preservation Act of 1974, and the 1973 Procedures of the Advisory Council on Historic Preservation require that care must be taken to identify cultural resources and minimize adverse effects on them when Federal permits are issued. Because surface mining requires a drastic modification of existing conditions on the site of mining and spoil disposal, and because it may affect adjacent lands adversely through road construction, landslides, erosion, and flooding, the opportunity for adverse effects on historic, architectural, scientific, and archaeological resources exists. Contact with the West Virginia State Historic Preservation Officer (SHPO) has confirmed that existing inventories of West Virginia cultural resources are incomplete, and individual professional assessments of each proposed surface mine site will be necessary to determine whether any resources that may be eligible for listing on the National Register of Historic Places are present (By letter, Mr. Leonard M. Davis, SHPO, West Virginia Antiquities Commission, 5 November 1976).

US-EPA proposed guidelines for EISs on new-source NPDES permits allowed the US-EPA to request that applicants consult with the SHPO to demonstrate US-EPA compliance with the requirements cited in the preceding paragraph (40 CFR 6.920.2.3; 40 FR 47717, 9 October 1975). Reference to the SHPO was deleted from 40 CFR 6.920 in the final regulations (42 FR 2456, 11 January 1977). The West Virginia SHPO is likely to insist that applicants routinely perform a professional survey of project sites before his consultation can be completed. At present, such surveys

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[1] US-EPA apparently has not applied these non-NEPA coordination requirements to existing-source NPDES permits, although there is no published routine exemption of existing sources from any Federal law except NEPA. Because existing surface coal mines typically can affect the listed resources adversely to the same extent as proposed new sources --- at least on their holdings of as-yet unmined land --- US-EPA may seek to apply these requirements to existing-source permits in advance of any implementation of new-source regulations. Because of its generally transitory nature, the surface coal mining industry differs substantially from many industries regulated under NPDES. A vigorous enforcement of the existing coordination requirements for existing mines at least would afford some partial measure of scrutiny to selected resources prior to the implementation of the new-source program.

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are not routinely accomplished by applicants for surface mine permits. It will be essential that US-EPA inform applicants of this responsibility, so that timely surveys reduce the opportunity for avoidable delays during the permit review process. It is the opinion of the West Virginia SHPO that unknown cultural resources probably exist in the regions where surface mining can take place, and that these resources must be identified by professional survey, if adverse effects from future surface mining are to be reduced, avoided, or mitigated.

Wetlands

There are limited areas of freshwater wetlands in West Virginia which potentially can be affected through surface coal mining by means of erosion and siltation or acid mine drainage in the watersheds above them. Known wetlands are inventoried in Chapter II of this report; a current inventory probably would reveal others. Greenbrier, Preston, and Tucker Counties currently have surface coal mining; Pocahontas County has surface minable reserves.

Coastal Zones and Coastal Waters

West Virginia is an inland State, and coastal resources will not be affected by surface coal mining, except for that fraction of surface-mined coal which enters international trade.

Floodplains

New surface coal mining in West Virginia potentially could affect agricultural, industrial, commercial, or residential development in currently undeveloped floodplains. US-EPA, therefore, must be prepared during new-source NPDES reviews to "take flood hazards into account when evaluating plans and ... encourage land use appropriate to the degree of hazard involved" (Section 1.4., Executive Order 11296, 10 August 1966).

Wild and Scenic Rivers

The people of West Virginia derive a significant part of their income from the tourist and recreation industry. The travel industry accounts for 7% of employed West Virginians, as compared with 8.4% in (underground plus surface) mining and 4.8% in the chemical industry (WV-DOC 1976:58). Wild and scenic rivers are important attractions for visitors to the State. Such rivers have been designated, and others are in the process of being designated, under State and Federal legislation, as indicated in Chapter II of this report. For example, the Cranberry River (a tributary of the Gauley River) is protected from impoundments by the Natural Stream Preservation Act of 1969 (West Virginia Code 20-5B). The Cranberry River Basin contains strippable coal reserves, and the degree of protection by the State Act against adverse impacts from mining remains to be demonstrated.

Dams

Surface coal mining probably will not entail the control or structural modification of streams, so coordination relating to these activities seldom will be required for NPDES permit applications.

Imperiled Biota

A comprehensive, computerized inventory of known stands of unique vegetation and of habitats for animals classified as threatened or endangered is being completed by the WV-DNR in cooperation with The Nature Conservancy. When this inventory is operationalized (1977 or 1978), it will be possible to ascertain conveniently whether proposed surface mining on specific sites is likely to affect these known resources, by contacting these agencies. In order to protect the resources, the results of the inventory are unlikely to be published. US-EPA Region III therefore may find it desirable to require routine formal coordination between applicants and these agencies to insure early identification of important biotic resources.

The data in the inventory will require cautious use. It is doubtful that the computerized inventory ever will be complete. Such data, however useful for rapid environmental screening, are no substitute for on-site field inspection during full NEPA reviews.

Agricultural Land

It is possible that surface mining in West Virginia occasionally will affect at least locally-significant amounts of prime agricultural land adversely, and the Secretary of Agriculture occasionally may have to be consulted.

Information Required From Applicants

The US-EPA has prepared a New Source and Environmental Questionnaire that is to be completed by applicants for NPDES discharge permits. This questionnaire provides a limited amount of undocumented information on the environment and on potential impacts of new source industries, but the questionnaire is not tailored specifically to the surface coal mining industry in West Virginia. The current questionnaire used by US-EPA Region III is outlined in the Appendix. On the basis of the NS/EQ, US-EPA must decide (within 5 to 45 days after the proposed mine has been determined to be a new source) upon the exact scope of the environmental assessment that the applicant will be required to make -- none, an EIA, or a third-party EIS (42 FR 2450, 11 January 1977).

The US-EPA (1975a) also has prepared a manual of "Environmental Impact Assessment Guidelines for Selected New Source Industries," which is to guide applicants for permits in preparing environmental impact assessment reports (EIAs) on projects that will have significant adverse environmental impacts. These guidelines presumably would be used also by consultants in developing third-party-agreement EISs. The information required by these guidelines is much more comprehensive than that required by the NS/EQ.

To some extent the guidelines request information that an applicant proposing a surface coal mine already must develop for the several West Virginia mining permit applications. Because the US-EPA (40 CFR 6.908.b; 42 FR 2452, 11 January 1977):

> shall not require the applicant to gather raw data or to perform analyses either of which duplicate existing data or the results of existing analyses available to EPA,

it presumably is essential that US-EPA Region III require the applicant to submit completed copies of all State mining applications as part of his EIA when a full NEPA review is conducted.[1] The content of the West Virginia applications is compared to US-EPA guidelines in Table 38.

The State applications require detailed information on the proposed mining methods to be used, on reclamation plans including revegetation and sediment control, and limited original data on existing water quality. In addition, information on existing conditions of topography, geology, soils, hydrology, and land uses at and in the immediate vicinity (within 1,000 feet) of the mine must be presented. According to State law the Director of the West Virginia Department of Natural Resources is empowered to delete areas from mine applications that

> are impossible to reclaim either by natural growth or by technological activity [because] if surface mining is conducted in these certain areas such operations may naturally cause stream pollution, landslides, the accumulation of stagnant water, flooding, the destruction of land for agricultural purposes, the destruction of aesthetic values, [and] the destruction of recreational areas and the future use of the area and surrounding areas, thereby destroying or impairing the health and property rights of others, and in general creating hazards dangerous to life and property so as to constitute an imminent and inordinate peril to the welfare of the State, and such areas shall not be mined by the surface-mining process (Code of West Virginia 20-6-11).

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[1] At present the West Virginia instruction booklet for surface mining permit applications advises applicants to submit the "Short Form C" existing-source NPDES application form to US-EPA well in advance of State applications (West Virginia Surface Mining and Reclamation Association 1974). This procedure can be revised for new-source NPDES applications, to avoid needless duplication of effort. The current booklet does not mention the new-source NPDES program, or the new-source pre-application consultation recommended by US-EPA during 1974.

Table 38. Outline of information requirements for environmental impact assessments of proposed new source permits for surface coal mines in West Virginia, based on US-EPA (1975a). Underscored information is required for current State mining permit applications.

- Description of Proposed New Source
  - Overview
  - Summary of major features
  - Detailed description of proposed mine operations
    - Haul roads
    - Mining schedule
    - Methods to remove and stockpile topsoil
    - Mining methods and sequence
    - Blasting
    - Handling of toxic and acid-forming materials
    - Methods to control overburden after placement
    - Underground workings to be encountered
    - Methods to seal deep mines
    - Methods to seal auger holes
    - Methods for drainage control and sediment retention
    - Nature of wastewater discharges and methods to treat runoff
    - Regrading methods and schedule
    - Revegetation procedures
    - State bond requirements
    - Energy requirements
    - Air and solid waste pollution sources
    - Efficiency of proposed coal resource recovery
- Environment Without the Proposed Action
  - Description of baseline conditions
    - Meteorology and climatology
    - Air quality
    - Topography
    - Geology
    - Soils
    - Water quantity
    - Water quality
    - Existing and potential water pollution problems
    - Water uses
    - Water quality management efforts in the watershed
    - Flood hazards
    - Terrestrial biology
    - Other environmentally sensitive areas
    - Local land uses and trends
    - Population projections and economic forecasts
    - Other projects and public programs in the area
  - Projection of conditions without the project

Table 38. Outline of information requirements (concluded).

- Assessment of Impacts
  - Identification of impacts
    - Pollution control facilities, equipment, and manpower
    - Monitoring systems
    - Regulations and performance standards
    - Uncertainties of waste generation
    - Appropriateness of treatment system
    - Labor force requirements
    - Payroll
    - Noise generation
    - Transportation requirements and effects
    - Effects on project site
    - Potentials for accidents and spills
    - Effects on environmentally sensitive areas
    - Effects on population levels
    - Effects on other and public projects
    - Effects on land use plans
  - Description and evaluation of impacts
    - Methodology
    - Significance and magnitude
    - Inevitable and possible effects
    - Cumulative effects
    - Primary and secondary effects
    - Long-term and short-term impacts
    - Reversibility of impacts
  - Aggregation of impacts
  - Comparison of impacts with future conditions without the project

- Alternatives to the Proposed New Source
  - Alternative mining methods
  - Postponement pending development of new technology
  - Alternative mine sites
  - Alternative water quality control facilities
  - Alternative reclamation and revegetation procedures

The Legislature did not delineate "these certain areas" or cause them to be delineated on maps. The Director of WV-DNR must delete from State surface mining permits any areas on which mine operations will constitute a hazard to any dwelling house, public building, school, church, cemetery, commercial or institutional building, public road, stream, lake, or other public property; and he must not approve surface mining in areas within one hundred feet of any public road, stream, lake or other public property (except for haul roads or stream dredging), or where the operation adversely will affect a State, National, or interstate park, unless adequate screening and other approved measures are to be utilized and the permit application so provides.

Surface mine applicants must publish notice of their permit applications in the counties of the proposed mines according to a State-mandated format, and evidence of this publication becomes a part of the State mining application (See the Appendix). Written protests are accepted by the State at least 30 days following the initial date of notice publication. Reputed owners of land within 500 feet must be notified by certified or registered mail and informed of their right to protest to the State during the 10 days following notification. Should US-EPA seek to utilize this opportunity for public involvement in NPDES decisionmaking, it should explore a joint requirement with the State, so that public notices could include the information that a Federal as well as a State permit will be required, together with the address for letters of protest directed to US-EPA Region III. The added information probably would add a minimal additional burden to an applicant, if it were incorporated routinely in the text of public notices. Protests could alert US-EPA personnel to mines in need of special environmental scrutiny.

Information that is available from State mining applications differs from the information requirements of the NPDES "Guidelines" document (US-EPA 1975a) in three basic ways. First, the range of subjects addressed by the State applications is less comprehensive than the new-source guidelines. The State requirements are specific to mining, reclamation, and discharge aspects, but they do not cover the environment generally. Second, they present a single proposal by the applicant, with no consideration of alternative methods of accomplishing the purpose of the applicant. Third, they address only one mine, not the total and cumulative effects of all surface, or surface plus deep, mines and other sources of pollutants in the watershed.

US-EPA Region III could develop a checklist that may be furnished to applicants along with the NS/EQ to cover site-specific sensitive resources and complement any areawide data compiled by US-EPA Region III, depending on the usefulness of the additional information for screening applications prior to full NEPA review, and for providing a basis for non-NEPA coordination activities which will be necessary irrespective of the NEPA review.

The following discussion of water quality aspects of the current NS/EQ may be useful to illustrate the need for such a checklist. At present, only one question on the NS/EQ deals with potential impacts on the aquatic environment (Question IV.1.d.):

> Are any of the normal expected pollutant concentrations in the discharge known to you likely to adversely affect human or other plant or animal health or the aquatic environment? yes [ ] no [ ]
>
> If yes, explain, indicating what steps will be taken to reduce or eliminate such potential damage.

No supporting information or analysis for the answer given to the question is implied or requested, and no need for any professional competence to make the required assessment of impacts is stated. It will be difficult for the US-EPA either to concur or to question the answer given by the applicant without supporting information. The NS/EQ does not state that such supporting information must be attached to the questionnaire form. This type of problem is characteristic of the NS/EQ, and it may affect any environmental screening or NEPA review based on the NS/EQ.

Public Involvement

As indicated on the preceding page, US-EPA Region III could cooperate with the State of West Virginia to insert notice of the fact that Federal as well as State permits will be required for new surface coal mines in the State-mandated standard format for local public notices. This could be part of the public notification required in 40 CFR 6.906.g.3. A second opportunity for the public notice is furnished by the required publication of negative declarations or notices of intent at the conclusions of NEPA environmental reviews (40 CFR 6.908.d.1 and 2). It is not clear whether there is to be any public notice, if applications are exempted from NEPA review because of threshold tonnage exemptions with or without preliminary environmental screening, because this potential procedure is not covered by existing regulations. Presumably there still would be opportunity for public comment on the notice of intent to issue the NPDES permit.

IV. CONCLUSIONS AND RECOMMENDATIONS

As US-EPA develops its final regulations for the coal mining industry under the new-source NPDES permit program, it must weigh the potential effects of those regulations on the West Virginia surface coal mining industry and on the human environment. During the near future, US-EPA Region III will administer the new-source NPDES program for West Virginia. It therefore must develop a regulatory strategy for compliance with NEPA, other Federal environmental statutes, and the regulations of US-EPA and other Federal agencies that are applicable to Federally issued new-source NPDES permits.

From the analyses conducted for this report, it appears that an areawide approach to environmental review of new-source coal surface-mining applications will be the soundest way to achieve compliance with NEPA and other relevant Federal requirements. As US-EPA has noted,

> [t]he most effective way to comply with NEPA on new source coal mine permits is to assess new coal mining activity on an areawide basis. [An] environmental analysis ... will document the full range of impact ... apply NEPA effectively to new mining operations and at this same time avoid significant disruption to the permitting of new and needed operations that are environmentally sound (41 FR 19840, 13 May 1976).

The form such an analysis will take remains undefined. US-EPA Region III is reluctant to prepare one or more formal EISs on the West Virginia surface mining industry, because such a procedure apparently will stop the issuance of any new-source NPDES permits for the industry that have not undergone their own formal EIS reviews. It therefore appears to be the prudent course for US-EPA to proceed immediately with areawide environmental assessments on priority mining areas for in-house use during the review of permit applications. As these inventories and analyses become available, they will facilitate the rapid, routine environmental review of applications by comparison of proposals with maps of known sensitive areas, in combination with routine consultations between applicants and other agencies (for example, the SHPO and West Virginia Antiquities Commission). They therefore will form a crucial part of the NEPA environmental review process that culminates in the public notice of either a negative declaration or a notice of intent (and eventual draft and final EISs). They will help applicants prepare necessary environmental analyses with a minimum of effort devoted to retrieval of known facts, and they will provide information to related US-EPA programs and to other agencies concerned with the environment of the State.

Depending on US-EPA resources available to accomplish the areawide inventories, they should be established as ongoing collations of environmental information, which are updated routinely either continuously or at regular intervals. US-EPA Region III should develop water quality models for wastes from the mining industry in West Virginia, together with a precisely specified list of the data requirements necessary to apply the models.

When an individual applicant proposes to mine a minor watershed that previously has not been inventoried, he legitimately may be required to develop all sections of the inventory for the watershed to the appropriate level of detail, and calibrate the appropriate model. Thus, for example, he might be required to investigate aspects of surface hydrology, water quality, aquatic biology, and existing point and non-point discharges throughout his minor watershed; but archaeological resources, only on and adjacent to his proposed mine site. Each applicant should be expected to utilize all information previously developed for his watershed, and to update and supplement the existing information as appropriate. In this way each applicant benefits by environmental analysis that has gone on previously, and the risk that US-EPA will make piecemeal decisions is minimized. Sensitive areas least able to accept further mining become increasingly well known, and mine operators can plan means to minimize adverse effects or mitigate unavoidable adverse effects positively.

Threshold exemptions from routine, detailed NEPA review and from "Best Practices" based on tonnage of coal produced are beset with practical difficulties of implementation to the West Virginia surface coal industry, as described in Chapter III. They have not yet been described by proposed regulations in the Federal Register or in final written guidance to Regional Administrators, and their effects on (1) the public involvement aspects of NEPA review and (2) the accomplishment of interagency coordination requirements based on laws other than NEPA are difficult to anticipate. Such exemptions will have to be justified fully in EISs on the overall US-EPA new-source NPDES program for the surface coal mining industry in West Virginia.

Finally, a comprehensive NEPA review and interagency coordination in accordance with current US-EPA guidelines (40 CFR 6; 42 FR 2450-2459, 11 January 1977) cannot be achieved unless the NS/EQ questionnaire currently being furnished by US-EPA Region III to West Virginia new-source NPDES applicants is supplemented by additional information requests to the surface coal mining applicants. The summary questions of the current NS/EQ do not address the full range of issues raised by the US-EPA guidelines document for new-source industrial NPDES permits (US-EPA 1975a). Moreover, the current questionnaire does not require, and indeed does not suggest, that documentation of assertions made in it be attached. Thus it will not be possible for US-EPA Region III either to concur in or to challenge the conclusions of an applicant based on his data.

US-EPA is embarking on a major, long-term regulatory program with respect to the West Virginia surface coal mining industry. The industry has in the past caused vast, irreparable damage to the human environment of the State and of the Nation. It was not the charge of this report to document such damage; the reader is referred particularly to the numerous Congressional documents listed in the Bibliography. State regulations have curbed some of the past excesses of the industry, but the Federal mandates for environmental scrutiny and regulation of the industry are considerably broader than parallel West Virginia requirements at the present time. The consultant therefore recommends the following actions to US-EPA:

1. Initiate Areawide Environmental Assessments

US-EPA Region III should identify the resources it realistically can allocate to environmental assessment for the West Virginia new-source NPDES program, and begin to compile assessments for those regions which it views as having the highest priority, on the basis of information presented in Chapter I of this report and other sources. US-EPA Region III may opt to consult directly the public, the surface mining industry, and the State of West Virginia in setting its priorities. The data accumulated and analyses performed for the West Virginia surface mining environmental inventory and assessment should be coordinated closely with any similar efforts for new-source NPDES environmental review of the underground mining industry and of other industries in the State, because much of the information gathered will be equally applicable to other industrial activities as to surface coal mining.

The consultant recommends that US-EPA Region III give high priority to areawide assessments in Mining Subregions I (main section), II, and V (Figure 7). These are the major current mining areas of the State, and clearly will have major continuing activity during the near-term future. Interruptions to mining activity in these areas could cause substantial economic dislocation.

Relatively low priority can be given to other regions for the following reasons: The Ohio River section of Subregion I has only a few small mines, which can be reviewed individually. Subregion III, the Shavers Fork Basin, is controlled mainly by the US Forest Service, which at present opposes surface mining and has received court support for its position. The scattered, individual mines on surface land not owned by the Federal Government can be reviewed individually. Subregion IV has relatively little current surface mining, and most new activity will be by large mines that may be covered by "Best Practices". These can be given full environmental review as they are received.

US-EPA Region III should review its priorities periodically, and alter them as future circumstances and the flow of permit applications dictate.

An appropriate geographical scale for the presentation of environmental information is 1:24,000, the scale of the 7.5-minute topographical quadrangles published by the United States Geological Survey. Excerpts from appropriate quadrangles already are required by the NS/EQ. Any smaller scale is likely to preclude accurate local delineation of sensitive resources in mountainous West Virginia. State mining applications currently require engineering drawings at a scale of 1:6,000. Unless the US-EPA is unwilling to accept State review and biweekly inspection of mine engineering aspects of surface mining applications, it probably is not necessary for US-EPA routinely to conduct its environmental review at such a large scale, at least until significant resources have been identified and proposed avoidance of effects or mitigation for unavoidable effects are under scrutiny within individual mine sites during detailed NEPA reviews.

The areawide inventories should be made available to applicants for their use in avoiding areas known to have sensitive resources, and known therefore to require extended periods of coordination to reduce adverse effects. Should there be successful court challenges to US-EPA procedures which require EISs, the areawide effort already accomplished will reduce the time required for completion of the EISs by US-EPA.

2. Pass Costs of Environmental Analyses to Applicants

US-EPA apparently lacks at present the statutory authority to impose fees to cover the processing of NPDES applications (Verbally, Mr. Peter Cook, Office of Federal Activities, US-EPA, Washington DC, 15 February 1977). Other agencies[1] have been granted such authority, and US-EPA should investigate the potential for equivalent enabling legislation if necessary.

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[1] The US Department of the Interior, for example, was granted authority to charge fees for processing applications, for other administrative costs, and for associated activities such as environmental monitoring and EISs, related to rights of ways for oil and gas development across Federal lands by the Mineral Leasing Act (Title 1, Section 28; P.L. 93-153). This authority has been implemented through a variable fee based on the extent of Federal lands utilized. If the calculated non-returnable fee is less than $10 thousand, then it is the total payable fee. If the fee is greater than $10 thousand, the Department has accepted segmented payments. The Interior Department's authority to impose a filing and service (including environmental review) fee on applicants recently was reaffirmed by the Organic Act (P.L. 94-579). Regulations for implementing this authority are under development (By telephone, Mr. W. Downey, Finance Division, USDI, Washington DC, 22 February 1977). USDI typically retains a consultant directly to prepare an EIS, without need for third-party agreements (Verbally, Ms. L.K. Stone, P.E., Chief, Energy Facilities Staff, USDI, 15 February 1977).

The Corps of Engineers recently established a fee of $100 to process commercial permit applications under Section 404 of FWPCA and other acts which regulate activities in navigable waters (33 CFR 209.120; 41 FR 240: 55524, 21 December 1976).

The Delaware River Basin Commission (DRBC), an Interstate Agency, also imposes an environmental review fee on non-public applicants for projects that are within its purview under Section 3.8 of the Delaware River Basin Compact and in accordance with the Comprehensive Plan published by DRBC. An environmental questionnaire must be submitted by the applicant as part of the information required by DRBC. DRBC then determines whether the applicant must prepare an environmental assessment report. DRBC has established a $1,500 fee to cover staff review of such a report. The notice of intent to issue a negative declaration (with a 15-day period for objections) or EIS then is published by DRBC in local newspapers. Should an EIS be judged necessary, applicants are required to pay a $30 thousand environmental fee and are advised to expect a minimum delay of seven months in project approval. In addition to these environmental processing fees, there is also a filing fee equivalent of 0.1% of the total estimated construction cost (including land acquisition, planning, and related expenses) up to $1 million in construction cost plus 0.02% of the excess over $1 million: the filing fee for any project, however, is not to exceed $50 thousand (exclusive of environmental fees; by telephone, Mr. W. Thursby, Head, Environmental Unit, DRBC, 22 February 1977).

Several States have similar cost-recovery mechanisms. The State of Washington imposes a $25,000 fee on major projects that undergo comprehensive review through its "one-stop" permit program. The New Jersey Department of Environmental Protection also imposes

The internalization of the maximum portion of environmental assessment costs within the surface coal mining industry, as opposed to the defrayment of these costs out of general public funds, is a desirable goal for US-EPA, because the real environmental analysis, review, and protection costs of surface mining should be reflected in the price of coal. Such costs long were reflected only in the deterioration of the West Virginia environment (Stanford Research Institute 1972).

Until US-EPA can obtain authority for direct pass-through of its staff and consultant environmental costs to NPDES applicants, it should encourage the adoption of third-party agreements for those applications that will require individual-mine EISs. In this way US-EPA resources can be husbanded for use on areawide assessments and on regulatory strategy development. There is at present insufficient experience with third-party agreements to demonstrate the advantages and disadvantages of this arrangement. It would no doubt be preferable, however, for US-EPA to hire its own consultant directly to prepare an EIS, because any appearance of conflict of interest on the consultant's part that could arise under a third-party agreement thereby can be eliminated.

3. Routinely Require Sufficient Information From Applicants

The current New Source and Environmental Questionnaire used by US-EPA Region III should be supplemented, so that it (1) routinely requires interagency coordination (particularly for cultural resources and biological resources) and (2) provides the documentation on which assertions are based. This supplement should be designed for maximum utility, given the procedure US-EPA Region III adopts with respect to any threshold exemptions of mines from detailed environmental review.

4. Develop Geographically Tailored Regulatory Strategy

Probably the strongest justification for dispensing with a full-scale NEPA review of new-source surface mining applications from West Virginia would be that US-EPA Region III has developed a geographically sensitive regulatory strategy to prevent damage to sensitive resources. A comprehensive, ongoing environmental inventory and modeling analysis would provide the basis for US-EPA Region III to issue surface-mine discharge standards more stringent than those adopted Nationwide for appropriate watersheds in West Virginia, and could insure the maintenance of State water quality standards. Such a strategy cannot be developed on the basis of existing information. It would represent a significant advance over the current State practice of water quality reviews aimed always at single mines in isolation.

5. Apply Environmental Coordination Requirements to Existing-Source Surface Mines

As discussed in Chapter III, US-EPA heretofore apparently has not applied the several Federal laws and regulations that require interagency coordination regarding certain classes of resources to the issuance of existing-source NPDES permits. There apparently is no specific authority

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a variable fee for projects which it reviews under the Coastal Area Facility Review Act (Chapter 185, New Jersey Laws of 1973). For residential projects there is a $500 filing fee plus $10 per proposed dwelling unit; for non-residential or mixed uses, the fee is $1,000 plus $10 per developed acre.

for exempting existing sources from these regulations comparable to 40 CFR 125.43. Given the fact that these requirements offer a measure of environmental protection to resources not addressed by West Virginia laws, and given the fact that numerous existing-source NPDES permits covering an unknown, but presumably substantial, quantity of unmined land are to be issued for the West Virginia surface mining industry, there is apparently an opportunity for US-EPA to carry out its mandate for environmental protection over and above its eventual implementation of the new-source NPDES program. As of March 1977, there were more than 1,000 existing-source NPDES permit applications pending with US-EPA Region III (Verbally, Mr. L. Benning, Chief, West Virginia Section, US-EPA Region III, 15 March 1977). It appears unlikely that the anticipated "batch processing" of these applications will optimize environmental protection, unless care is taken to implement non-NEPA coordination prior to permit issuance. Granted that some of the mines will have completed operations and reclamation prior to NPDES permit issuance, there nevertheless is likely to be previously unmined land with environmental resources that, if they are recognized, could be afforded some measure of Federal protection.

6. Coordinate Regulatory Program for Surface Mines With NPDES Analyses of Deep Mines and Other US-EPA Wastewater Programs

US-EPA Region III should coordinate its regulatory strategy for the West Virginia surface coal mining industry with any inventory or monitoring efforts that may be underway for deep mines or other US-EPA wastewater management programs in West Virginia. Information on current and proposed point and nonpoint discharges to waterways that are proposed to be affected by new-source surface coal mines is basic to any assessment of the impacts of the proposed new sources. Likewise, information generated through surface coal mine assessments will be valuable to other regulatory efforts in West Virginia. In particular, the new-source NPDES program portends a major quantity of recordkeeping over a period of many years. US-EPA Region III should give careful thought to the design of an appropriate information and retrieval system for the data, and particularly for their display on file maps.

7. Avoid Duplication of Regulatory Effort

Because the resources which US-EPA Region III can apply to environmental review of new-source NPDES permit applications are limited, they should be utilized in a manner which maximizes the amount of environmental planning that actually is accomplished in accordance with the mandate of NEPA. US-EPA should avoid duplication of effort expended by other agencies, and instead should rely on routine interagency consultation during the processing of permit applications. For example, it would be unnecessary for US-EPA Region III to attempt to duplicate the engineering review of surface mine applications that currently is performed by the WV-DNR Division of Reclamation, unless there is an extraordinary concern with a particular mine. When there are violations of water quality standards and discharge limitations, or other infractions or overlapping State and Federal regulations, US-EPA should cooperate with the State to maximize the likelihood that the violations are corrected and environmental damages are repaired. The central thrust of US-EPA efforts should be to make certain that Federal environmental mandates are followed for those aspects not covered by State or local authority.

8. Enforce "Best Practices" and NPDES Permit Conditions Vigorously

The present report deals only with implementation of environmental assessments under the new-source NPDES program for surface coal mines in West Virginia, not with enforcement after permits are issued. The consultant is struck, however, by the apparently massive commitment of US-EPA Region III resources to enforcement that will be necessary to insure actual mining in accordance with NPDES permit conditions and especially with existing drafts of "Best Practices" guidelines. Surface coal mining in West Virginia increasingly takes place in remote, high-elevation areas spread geographically across much of the State, where the potential for environmental damage to sensitive resources is great. It will be no small matter for US-EPA Region III to assure compliance with detailed requirements of individual NPDES permits or "Best Practices". Should enforcement be inadequate, however, regulations on paper will have little meaning in the West Virginia mountains.

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Approved by:

Frank A. Camp, Ph.D.
Vice President

James A. Schmid, Ph.D.
Vice President

Alfred M. Hirsch

Alfred M. Hirsch, Ph.D.
Executive Manager

Appendix A. Outlines of Current Permit Application Information Requirements

1. NPDES New Source Environmental Questionnaire (NS/EQ)
2. NPDES Permit Application, Short Form C
3. West Virginia Prospecting Permit for Surface Coal Resources
4. West Virginia Surface Mining Permit Application (Form DR-4)
5. West Virginia Mining and Reclamation Plan (Form DR-5)
6. West Virginia Mine Drainage Application
7. Drainage Plans in Accordance with WV-DNR Drainage Handbook
8. Final Grading Maps and West Virginia Final Planting Plan Report (Form DR-8)
9. West Virginia Final Inspection Report (Form DR-9)
10. West Virginia Surface Mine Inspection Report (Form DR-6)
11. West Virginia Report of Non-Compliance (Form DR-15)
12. West Virginia Inspection of Non-Compliance (Form DR-16)
13. West Virginia Mine Production Report

NS/EQ NEW SOURCE ENVIRONMENTAL QUESTIONNAIRE FOR WASTEWATER DISCHARGES, NPDES SYSTEM

I. Identification of Applicant and Facility
   1. Applicant's name
   2. Applicant's address
   3. Location of proposed source
   4. Applicant's contact person
   5. SIC code for facility
   6. Date discharge is to begin
   7. New facility or alteration of existing facility

II. Status of Construction
   1. Date of land purchase or lease
   2. Date options expire on alternative sites
   3. Contractual obligations committed to new source
   4. Expected contractual obligations to be made
   5. Date land clearing begins
   6. Date excavation begins
   7. Date other site preparation begins
   8. Date erection of structures begins
   9. Date equipment is installed
   10. Expected total cost of facility

III. Facility Description
   1. Nature of wastewater discharge source
   2. Site plan of facility
   3. Features of site
      a. Map showing location of source
      b. Nature of land use in area
      c. Natural features of area
      d. Waterway affected
      e. Site on public recreation or wildlife area or near Register-eligible historic or archaeologic site
   4. Size of site, size of buildings, number of employees
   5. Cost of construction (buildings, machinery, wastewater treatment facilities)

IV. Impacts
   1. Water
      a. Volume of wastewater discharged
      b. Frequency of discharge
      c. Contents of discharge
      d. Normal, expected pollutant concentrations expected to affect human or animal health or aquatic environment adversely
      e. Source of water used and volume withdrawn
   2. Air
      a. Emissions sources during construction and operation
      b. Quantity and nature of emissions from each source
      c. Emissions subject to regulation and control measures proposed
      d. Emission of odors and measures to reduce or eliminate offense to public
      e. Emissions likely to affect human, animal, plant health adversely and measures to reduce or mitigate
      f. Proposed facilities for which New Source Performance Standards or National Emission Standards for Hazardous Air pollutants have been promulgated

NS/EQ ENVIRONMENTAL QUESTIONNAIRE (CONCLUDED)

3. Noise and Traffic
    a. Ambient noise standards violations outside property line and measures to reduce effects during construction and operation
    b. Traffic problems in or around the new plant and measures to reduce problems
4. Solid Waste
    a. Plans for disposal of construction solid wastes
    b. Types of solid wastes generated during operations
    c. Plans to collect, store, and dispose each type of waste
5. Land Use
    a. Effects of construction and operation on surrounding area
        (1) Residential or commercial development
        (2) Traffic volume
        (3) Land use changes
        (4) Effects on future uses of plant site
    b. Zoning restrictions on site and conformance of plans with zoning

V. Miscellaneous
1. Alternative sites considered and reasons for rejecting them
2. Social and economic benefits expected from operation of proposed facility

NPDES APPLICATION FOR PERMIT TO DISCHARGE, SHORT FORM C

1. Name, address, location of applicant and discharge
2. Standard industrial classification (SIC Code)
3. Number of employees
4. If all waste discharged to a publicly owned treatment facility, give
    a. Name of organization that receives waste
    b. Name and address of facility that receives waste
    c. Do not complete remainder of form
5. Principal product of operation
6. Principal process
7. Maximum amount of principal product produced per day, month, or year
8. Units of measurement for item 7
9. Days per week and months during which discharge occurs
10. Daily volume of wastes discharged, and volume of each treated before discharge
11. Wastes discharged to other than surface waters
12. Number of separate discharge points
13. Name of receiving water
14. Does discharge contain, or is it possible for discharge to contain one or more of the following, as a result of operating this facility:

    aluminum
    ammonia
    beryllium
    cadmium
    chlorine (residual)
    chromium
    copper
    cyanide
    lead
    mercury
    nickel
    oil and grease
    phenols
    selenium
    zinc

ADDITIONAL REGION III EXISTING SURFACE COAL MINING NPDES PERMIT INFORMATION

1. Maps
    Submit 8.5 X 10-inch copy of USGS topographic map to show
    a. Existing work area
    b. Existing discharge points
    c. Proposed work area
    d. Proposed discharge points
    e. Wastewater receiving streams
2. Effluent Limitations
    a. Indicate whether discharges meet the following limitations (new mines must meet the limitations)
        (1) Mining Wastes

Parameter	Monthly Average	Daily Maximum
Total Suspended Solids	30 mg/l	60 mg/l
Total Iron	4 mg/l	8 mg/l
pH	6.0-9.0 at all times	
Alkalinity	greater than acidity	

NPDES APPLICATION FOR PERMIT TO DISCHARGE (CONCLUDED)

(2) Sanitary Wastes

Parameter	Monthly Average	Daily Maximum
Total Suspended Solids	30 mg/1	60 mg/1
Biochemical oxygen demand (5 day)	30 mg/1	60 mg/1
Fecal coliform bacteria	200/100 ml	600/100 ml

(3) During and for four hours following a major storm event (number of inches of rainfall greater than [storm duration (minutes) ÷ 100] + 0.2), the total suspended solids may exceed 60 mg/1, but must not exceed 1000 mg/1.

b. Provide compliance schedule for facilities not meeting limitations, no later than 1 July 1977.

3. Water Quality and Flow Analysis
Indicate average flows for all point source discharges. For flows greater than 500,000 gpd, information on the following parameters is to be provided. Analyses are by Standard Methods.

Flow
Total suspended solids
Total iron
pH
Alkalinity
Acidity

4. Indiate State mining permit number

WEST VIRGINIA PROSPECTING PERMIT APPLICATION FORM DR-3

Note: Any landowner may mine coal (without permit or fee) on his own property for household use (Code of West Virginia, Amended, 20-6-7).

1. Name of applicant
2. Address of applicant
3. Applicant's representative
4. Representative's address
5. Location of operation
6. Tract name
7. Minerals to be prospected
8. Geological name of deposit
9. Other prospecting or mining permits held and those now under bond
10. Surface owner(s)
11. Minerals owner(s)
12. Source of legal right to enter and mine land under permit
13. USGS map identifying oil/gas wells, deep mines, cemeteries, utilities on area of operations
14. Past revocation of permit or bond forfeiture
15. Officers and owners of applicant
16. Prospecting fee ($300 per permit); Reclamation bond ($500/acre)
17. Notarization of signature
18. Inspection by District Reclamation Inspector required prior to filing of application (not part of Form DR-3)

RECLAMATION PLAN (must be attached to Form DR-3)

1. Detailed explanation of
    - a. Future land use
    - b. Drainage control measures
    - c. Methods of regrading and topsoiling, with time schedule
    - d. Seed bed preparation
    - e. Soil preparation and treatment
    - f. Mulch type and rate
2. Method and agent to complete revegetation
3. Seasonal revegetation schedule and rate
    - a. Pasture and meadowland species, rate, location
    - b. Woodland and wildlife species, rate, location

WEST VIRGINIA SURFACE MINING PERMIT APPLICATION FORM DR-4

1. Name of applicant
2. Address of applicant
3. Applicant's representative
4. Representative's address
5. Location of operation
6. Tract name
7. Mineral to be mined and method
8. Geological name of deposit
9. Other prospecting or mining permits under bond
10. Surface owner(s)
11. Minerals owner(s)
12. Reputed owners of lands within 500 feet of proposed disturbed land

12a. Notification of reputed landowners

13. Source of legal right to enter and mine land under permit
14. Acreage to be disturbed (mine, access roads, drainage system)
15. Prospecting permit to be converted
16. Registration fee ($500 per permit)
17. Prospecting fee converted
18. Fee submitted
19. Reclamation bond
20. Converted prospecting bond
21. Total bond submitted (minimum $10,000)
22. Special reclamation tax ($60 per acre)
23. Officers and owners of applicant
24. Past revocation of permit or bond forfeiture

A. Pre-Plan Map must accompany this form.

PRE-PLAN MAP (CODE OF WEST VIRGINIA, AMENDED, 20-6-9)

1. Base: enlarged USGS topographic quadrangle or aerial photographs (sheets 8.5 X 11 inches)
2. Preparation by qualified professional
3. Include all of area in mining application
4. Show limits of
   a. Adjacent deep-mining operations
   b. Adjacent inactive or mined-out deep-mined areas
   c. Boundaries of surface and mineral ownership within 500 feet of disturbed area
   d. Names of adjacent surface and mineral owners
5. Approved scale (1:6,000 preferred for drainage map)
6. Name and locate on and within 500 feet of land to be disturbed
   a. Streams, creeks, or other bodies of public water
   b. Roads
   c. Buildings
   d. Cemeteries
   e. Active, abandoned, or plugged oil and gas wells
   f. Utility lines
7. Show
   a. Boundaries of land to be disturbed
   b. Crop line of seam or deposit to be mined
   c. Total acreage to be disturbed

WEST VIRGINIA SURFACE MINING PERMIT APPLICATION (CONTINUED)

8. Date of preparation, north arrow, topographic quadrangle name, latitude and longitude
9. Drainage plan on and away from land to be mined
    a. Directional flow of water
    b. Streams or tributaries receiving discharge
10. Location of acid-producing materials (overburden pH less than 3.5) and preparation for revegetation
11. Signature of preparer and notary

PUBLIC NOTIFICATION: WEST VIRGINIA CLASS III LEGAL ADVERTISEMENT AND REPUTED ADJACENT OWNERS

Upon approval of an applicant's application for a Surface Mining Application Number (SMA number), the applicant must publish notice of his permit application which contains the information from form DR-4, Items 1, 2, 5, 7, 8, 9, 10, 11, 12, 13, 14, 23 (officers only), and 24, together with identification of the affected watershed, latitude and longitude, and a location map showing the proposed operation, on a form provided by the WV-DNR for a Class III Legal Advertisement. Certification of publication becomes part of the permit application.

The advertisement must be published in the newspaper of each county in which the mining is to take place. The advertisement must run once each week for three consecutive weeks, with no more than six days between each ad and no more than 21 days between first and last. The advertisement must specify that written protest to the subject application will be received by WV-DNR for thirty days from the original date of publication of the advertisement.

All reputed owners of land within 500 feet of the area proposed for disturbance, bonded access haul roads, dugouts, ponds, and pond access roads must be notified by registered or certified mail. Certification of notification becomes a part of the permit application. Reputed landowners have no less than 10 days to file written protest with WV-DNR after the date of notification.

WEST VIRGINIA MINING AND RECLAMATION PLAN FORM DR-5
(signed by approved professional or engineer)

1. Name of applicant
2. Proposed type of operation
3. Future land use
4. Average soil pH before mining
5. Principal seam(s) and thickness(es)
6. Estimated mining period
7. Overburden or seams classified as acid producing
8. Underground workings to be encountered
   pH and iron concentration of active discharge from abandoned deep mines
9. Mining procedures (drawings, supplements, 8.5 X 11-inch paper)
   a. Mining sequence
   b. Plans for haul roads with typical cross section and profile of proposed grade
   c. Site preparation plans, including removal and disposition of trees and shrubs
   d. Detailed blasting procedure, and list of reputed owners within 1,000 feet
   e. Method for removing and stockpiling topsoil
   f. Method for placement of all overburden, including acid-producing and toxic material
   g. Method to control overburden after placement, especially on outer slope
   h. Procedure for final stabilization of overburden
   i. Mapped strike and dip of coal seam
10. Grading procedures
    a. Typical cross section of regrading
    b. Equipment to be used for regrading
    c. Method of spreading topsoil and approximate thickness of final topsoil layer
    d. Method of drainage control for final regraded area
    e. Method for testing soil after regrading
    f. Plan to neutralize acidity if pH less than 5.5
    g. Mechanical seed bed preparation on bench, terrace, and outslope
    h. Fertilizer analysis and application rate
11. Revegetation procedures
    a. Method and party to perform revegetation
    b. Mulch type and rate
    c. Seasonal revegetation schedule, species, and rate (pasture or woodland)
    d. Grazing and plans to protect vegetation
    e. Maintenance of vegetation until final bond is released

WEST VIRGINIA MINING AND RECLAMATION PLAN (CONCLUDED)

BLASTING PRE-PLAN

A blasting plan must be filed with the WV-DNR for every mine where blasting of overburden is necessary. A formula for restricting the weight of explosive detonated at one instant in time must be adhered to. The allowable quantity of explosive increases with the square of the distance to the nearest structure other than mine buildings. Structures include gas lines, telephone lines, electric lines, and oil or gas wells. Methods to produce delayed detonations (nine milliseconds or longer between detonations) must be described in detail. Records of each blast must be kept in a log for at least three years. For each blast other than boulder breaking, the log must show:

a. Date and time of blast
b. Number of holes
c. Typical explosive weight per delay period
d. Total explosive detonated at any one time
e. Number of delays used
f. Weather conditions
g. Signature of employee in charge of blast.

WEST VIRGINIA MINE DRAINAGE APPLICATION

1. Applicant name and address
2. Surface mine location
3. Mineral to be mined
4. Geological name of seam(s)
5. Type of operation
6. Affidavit and notary
7. Professional who prepared application
8. Substantive information
    A. Receiving stream
        1. Name of receiving stream
            a. Tributary to
            b. Tributary to
            c. Major drainage basin
        2. Minimum receiving stream flow and method used to determine flow
        3. Chemical analysis, one sample for each receiving stream downstream from discharge point
            a. Parameters to be analyzed by Standard Methods

(1)	pH	(6)	Total aluminum
(2)	Total hot acidity	(7)	Total manganese
(3)	Total mineral acidity	(8)	Total sulfates
(4)	Total alkalinity	(9)	Total suspended solids
(5)	Total iron	(10)	Dissolved solids

            b. Other information
                (1) Applicant and SMA file number
                (2) Name of individual who collected water sample
                (3) Date of water sample collection
                (4) Sampling station number, keyed to drainage plan map
                (5) Date of analysis
                (6) Name, address, and telephone of analytical laboratory
                (7) Signature of responsible analyst
                (8) Units of measure for parameters
    B. Proposal map
        Enlarged USGS topographic quadrangle (scale, 1:6,000) to show
        1. Limits of land to be disturbed, haul roads, and drainage system
        2. Crop line of seam or deposit to be mined
        3. Location and extent of auger mining
        4. Location of deep mine openings and extent of workings within 500 feet of proposed operation
        5. Location and thickness of all barriers to adjacent deep mines
        6. North arrow with dip and strike of seams to be mined
        7. Location and number of each test drill hole
        8. Legend and color code
    C. Drainage plan
        1. Enlarged USGS topographic quadrangle (scale, 1:6,000) to show
            a. (Same as B.1.)
            b. Location and name of all natural drainways and streams to be used in the drainage system
            c. Limits of drainage areas to be affected, with total area of all affected drainage areas
            d. Location of all sediment control ponds and structures

WEST VIRGINIA MINE DRAINAGE APPLICATION (CONTINUED)

- e. Location of all diversion ditches or constructed drainways
- f. Location of water sampling stations
- g. Direction of flow in drainageways and streams
- h. Location and sizes of bridges and culverts on haul roads within the area of operation
- i. North arrow with dip and strike of seam(s) to be mined
- j. Location and rate of flow of all deep mine discharges
- k. Legend and color code
- l. See items C.4., C.5., D.1.a., D.2.a.

2. Specifications and drawings for drainage structures (see attached outline of required drainage plans)
3. Operation will encounter groundwater?
4. Show springs within 500 feet of operation on Drainage Plan Map
5. Show any domestic wells within 1,000 feet of proposed operation on Drainage Plan Map

D. Adjacent mines
  1. For other surface mines within 500 feet of the proposed operation with ponds, pooled water, or seepage
    - a. Submit analysis as in A.3. and label sampling station on Drainage Plan Map
    - b. Indicate surface condition
  2. For deep mines within 500 feet horizontal distance or 100 feet vertical distance from the proposed operations
    - a. Submit analysis as in A.3. of any discharge, free-flowing or pumped, and label station on Drainage Plan Map
    - b. Indicate whether adjacent deep mine works contain impounded water
    - c. Submit plans for sealing deep mines encountered by the proposed operations, for both dry entries and entries with discharges

E. Auger holes
  1. Indicate depth of auger holes, if any
  2. Submit and explain cross-section with detailed plans to seal holes

F. Chemical treatment of wastewater
  1. If information on adjacent mines, seams to be mined, receiving stream water quality, and location of the proposed operation indicate that chemical treatment will be necessary
    - a. Submit description and drawings of proposed treatment system
      - (1) Reagent for pH adjustment
      - (2) Dispenser or contact unit to be used (make, model of proposed commercial unit) and limitations
      - (3) Aeration system
      - (4) Retention time to permit settling and stabilization
      - (5) Explain how chemical system will be used in conjunction with proposed drainage system
    - b. For any part of chemical treatment facility that is subject to flooding
      - (1) Probability that the system will be out of service is once in years
      - (2) Methods used for flood protection are
    - c. Chemical treatment system will be checked and maintained no less than once every hours

WEST VIRGINIA MINE DRAINAGE APPLICATION (CONCLUDED)

2. List reasons no system is being planned
3. If no system is planned, indicate actions that will be taken if unexpected pollution problems should arise in the course of the operations

G. Toxic materials

Submit cross-section with explanation showing location of possible toxic material and plans for placement of such material to prevent contact with water from infiltration or auger hole and deep mine drainages

H. Stream crossings

For any part of haul roads that contact or cross any stream, show location and sizes of culverts and bridges, with plans and specifications for bridges.

DRAINAGE PLANS IN ACCORDANCE WITH WV-DNR DRAINAGE HANDBOOK

A. Each embankment-type sediment dam
   1. Structure-proportioning computations sheet
   2. Construction plans to show
      a. Topographic map of reservoir area, embankment, emergency spillway
         (1) Scale 1:600
         (2) Contour interval: 4 feet
         (3) Method: transit-stadia survey or more accurate method
      b. Profile view of embankment along certerline of principal spillway, with dimensions, elevations, and principal spillway design
      c. Profile view of emergency spillway showing entrance and exit slopes and level section
      d. Cross-section of emergency spillway showing bottom width, side slopes, type of material
      e. Cross-section view along centerline of dam showing cutoff trench depth, original ground line, unsettled and settled dam heights, length of dam, etc.
   3. Stage-Area-Storage curves and computations sheet
   4. Construction specifications
B. Each excavated sediment pond
   1. (same as A.1.)
   2. Construction plans to show
      a. Plan and cross-section views with entrance and exit channels
      b. Cross-section view of embankment and emergency spillway (if used)
      c. Cross-sections at 50-foot intervals from the centerline showing original ground line and proposed excavation limits
   3. (Same as A.4.)
C. Each gabion sediment dam
   1. (Same as A.1.)
   2. Construction plans showing
      a. (Same as A.2.a.)
      b. Plan view showing all pertinent dimensions
      c. Cross-section at the point of maximum depth of impoundment against the structure showing all pertinent dimensions and elevations
      d. Cross-section along the centerline of the dam showing all pertinent dimensions and elevations
   3. (Same as A.3.)
   4. (Same as A.4.)
D. Each crib sediment dam
   1. (Same as A.1.)
   2. (Same as C.2.)
   3. (Same as A.3.)
   4. (Same as A.4.)
E. Each excavated sediment channel
   1. (Same as A.1.)
   2. Construction plans, each to show toe and top of spoil slope proximate to excavated channel
      a. Plan view of channel to scale
      b. Cross-section through channel showing maximum existing ground slope to scale
      c. Cross-section of typical barrier in channel

DRAINAGE PLANS IN ACCORDANCE WITH WV-DNR DRAINAGE HANDBOOK (CONCLUDED)

F. Each valley fill
    1. Three-dimensional sketch of the fill
    2. Profile of valley fill showing original ground line at 100-foot stations
    3. Cross-section through valley fill at midpoint of 2:1 outer slope with existing ground line as surveyed
    4. (Same as A.4.)

G. Each diversion ditch
    1. Diversion design computation
    2. Construction plans showing
        a. Surveyed profile along centerline of diversion showing original ground line and diversion bottom
        b. Channel cross-sections showing bottom width, side slopes, water depth
        c. Soil type(s) in which ditch will be excavated, based on soil excavation and classification at intervals not greater than 500 feet.
    3. Construction and vegetation specifications

FINAL GRADING MAPS AND WEST VIRGINIA FINAL PLANTING PLAN REPORT (DR-8)

Final maps showing final grading are to be completed and submitted to WV-DNR within 60 days of completion of mining. After inspection and approval of grading, the operator is entitled to a 75% ($750/acre) bond release, but a minimum bond of $5,000 is retained by WV-DNR.

After revegetation program is complete, the operator submits form DR-8.

1. Name, address of operator
2. Date mining completed
3. Date grading approved
4. Total acreage disturbed and planted
5. Planting completion date
6. Revegetation method
7. Species, rate/acre, location of planting
8. Actual cost of revegetation

Regrading, backfilling, and water management must be kept current, and progress grading reports may be required by WV-DNR. Reclamation must be completed witin 12 months of the cessation of mining. Inspection and evaluation of vegetation shall be made only after the planting has survived two growing seasons.

WEST VIRGINIA FINAL INSPECTION REPORT (DR-9)

1. Name, address of operator
2. Permit number
3. Permit acres
4. Date mining completed
5. Date grading approved
6. Total acres disturbed
7. Total acres planted
8. Date final planting plan approved
9. Date planted
10. Date(s) replanted
11. Planting contractor
12. Species planted
13. Method of planting (conventional, aerial, hydroseeding, other)
14. Haulageway properly abandoned
15. All acid bearing material properly treated
16. Vegetation satisfactory
17. Release of bond recommended
18. Comments and recommendations
19. Signatures: Inspector, date; Director, date

WEST VIRGINIA SURFACE MINE INSPECTION REPORT (Form DR-6)

As of January 1977 the West Virginia Division of Reclamation employed 32 inspectors, who were responsible for reporting on every surface mine in the State every 15 days. Most entries require a simple yes or no response. Warnings may be issued.

1. Name of operator
2. Permit number
3. Date of last inspection
4. Permit acreage
5. Estimated disturbed acreage at time of inspection
6. Status of operation active, inactive (explain), not started
7. Erection of signs according to regulations and approved plan
8. List of signs not in place
9. Implementation of drainage plan
10. Comparison of (ponded) water with standards (pH, iron)
11. Activity of discharge
12. Comparison of discharge water with standards (pH, iron)
13. Active chemical treatment of discharge
14. Encounters with underground openings
15. Active discharge from underground openings
16. Active chemical treatment of underground discharge
17. Haul road construction and maintenance according to regulations and approved plan
18. Tree and brush removal according to approved plan
19. Topsoil or surface material stockpiled
20. Execution of approved mining and reclamation plan
21. Adherence to blasting plan
22. Bench widths in accordance with slopes
23. Currency of reclamation
24. Comments and recommendations
25. Warning: The following measures must be taken by (date).
26. Signatures: District Reclamation Inspector, Company Representative

WEST VIRGINIA REPORT OF NON-COMPLIANCE (Form DR-15)

1. Mining company, location of mine, permit number
2. Date of inspection
3. Violation of Section of the Code of West Virginia and/or Section of the Rules and Regulations of the West Virginia Reclamation Commission
4. Description of violation
5. Order: operations must cease; permit is suspended; or, the following remedial measures must be accomplished by (date)
6. Failure to accomplish remedial measures within the time specified may result in suspension or revocation of permit and forfeiture of appropriate bond.
7. Date of issuance of report
8. Signatures: Director, Department of Natural Resources (by authorized agent); for operator
9. Copy to prosecuting attorney

WEST VIRGINIA INSPECTION OF NON-COMPLIANCE (Form DR-16)

1. Mining company, location of mine, permit number
2. Date of inspection identifying violation
3. Law and/or regulation violated
4. Description of violation
5. Remedial measures taken do (do not) release the operator from the non-compliance or violations
6. Date of issuance of report
7. Signatures: Director, Department of Natural Resources (by authorized agent); for operator

WEST VIRGINIA MINE PRODUCTION REPORT

These data are presented on a computer-input form monthly for the preceding month

1. Name of company
2. Name of mine
3. Mine permit number
4. Report date
5. County
6. Classification (gassy, non-gassy, other)
7. Mine status (operating, idle, closed temporarily, closed permanently)
8. Mine type (underground, surface, auger)
9. Haulage (track, belt, other)
10. Employment (inside, outside, supervisor, total man-hours, operating days)
11. Injuries (all accidents, lost-time accidents)
12. Underground production (conventional, continuous miner, hand loaded)
13. Total production (underground, surface, auger)
14. Seam mined
15. Rock dust applied (tons)
16. Distribution (railroad, truck, river, used locally)
17. Signature, title, date

BIBLIOGRAPHY

Adkins, James R., N. Islam, and M. S. Baloch. 1976. Comprehensive survey of the New River basin, Volume I Inventory. West Virginia Department of Natural Resources, Division of Water Resources, Charleston WV. 207 pp.

Applied Science Laboratories, Inc. 1971. Purification of mine water by freezing. USGPO, Washington DC. US Environmental Protection Agency, Water Pollution Control Research Series, 14018 DRZ02/71. 64 pp.

Army Corps of Engineers, Huntington District. 1973. Floodplain information, Ohio River, Cabell County/Wayne County, West Virginia. West Virginia Department of Natural Resources, Division of Water Resources. Variously paged, 48 pp.

Army Corps of Engineers, Huntington District. 1974. Final environmental impact statement, R. D. Bailey Lake, Guyandotte River, Wyoming County and Mingo County, West Virginia. By the District, Huntington WV. Variously paged, 106 pp.

Army Engineer District, Huntington, West Virginia. 1975a. Final environmental impact statement, Kanawha River navigation system, Fayette, Kanawha, Putnam, and Mason Counties, West Virginia. By the District, Huntington WV. 234 pp.

Army Engineer District, Huntington, West Virginia. 1975b. Kanawha River navigation charts, mouth to head of navigation. US Army Corps of Engineers, Huntington WV. 19 charts.

Babu, S. P., J. A. Barlow, L. L. Craddock, R. V. Hildago, and E. Friel. 1973. Suitability of West Virginia coals to coal-conversion processes. West Virginia Geologic and Economic Survey Coal-Geology Bulletin 1:1-32.

Bain, George L., and E. A. Friel. 1972. Water resources of the Little Kanawha River basin, West Virginia. West Virginia Geological and Economic Survey, River Basin Bulletin 2:1-122.

Barlow, James A. 1974. Coal and coal mining in West Virginia. West Virginia Geological and Economic Survey, Coal-Geology Bulletin 2:1-63.

Bitumunous Coal Research, Inc. 1968. Sulfide treatment of acid mine drainage. Bituminous Coal Research, Inc., Monroeville PA. Variously paged, 87 pp.

Bituminous Coal Research, Inc. 1970. Studies on limestone treatment of acid mine drainage. Commonwealth of Pennsylvania and the Federal Water Pollution Control Administration, Water Pollution Control Research Series DAST-33 14010.EIZ 01/70. USGPO, Washington DC. 96 pp.

Bituminous Coal Research, Inc. 1971. Studies on densification of Coal Mine Drainage Sludge. US Environmental Protection Agency, Water Pollution Control Research Series 14010 EJT 09/71. USGPO, Washington DC. 113 pp.

Blair, John P. 1974. The growth prospects of Nicholas County. Regional Institute, West Virginia University, Morgantown WV.

BOR (Bureau of Outdoor Recreation). 1976. Final environmental statement [on the] proposed New River Gorge National Wild and Scenic River, West Virginia. Prepared by the Northeast Regional Office, BOR, US Department of the Interior, Philadelphia PA. FES 76-42, variously paged, 148 pp.

Brooks, A. B. 1910. Forestry and wood industries. West Virginia Geological Survey Bulletin 5:1-481. Acme Publishing Company, Morgantown WV.

Broyles, Bettye J. 1968. Prehistoric man in the Kanawha and Ohio valleys. Proceedings of the West Virginia Academy of Science 40:32a-41a.

Broyles, Bettye J. 1976. A late component at the Buffalo site, Putnam County, West Virginia. West Virginia Geological and Economic Survey, Report of Archaeological Investigations 6:1-28.

Carlston, Charles W. 1958. Groundwater resources of Monongalia County, West Virginia. West Virginia Geological and Economic Survey Bulletin 15:1-32.

Carlston, Charles W., and George D. Graeff, Jr. 1955. Groundwater resources of the Ohio River Valley in West Virginia. West Virginia Geological Survey 22(3):1-131.

CEQ (Council on Environmental Quality). 1973a. Environmental quality, the fourth annual report of the Council on Environmental Quality. Washington DC. 499 pp. (Specifically, page 235).

CEQ (Council on Environmental Quality). 1973b. Preparation of environmental impact statements: Guidelines. 38 Federal Register 148: 20550-20562 (1 August).

CEQ (Council on Environmental Quality). 1973c. Coal surface mining and reclamation: an environmental and economic assessment of alternatives prepared at the request of Henry M. Jackson, Chairman, Committee on Interior and Insular Affairs, US Senate, pursuant to S. Res. 45, a national fuels and energy policy study. Committee print serial no. 93-9 (92-43). USGPO, Washington DC. 143 pp.

CEQ (Council on Environmental Quality). 1975. Environmental quality, the sixth annual report of the Council on Environmental Quality. Washington DC. 763 pp.

CEQ (Council on Environmental Quality). 1976. Memorandum to heads of agencies on Kleppe vs. Sierra Club and Flint Ridge vs. Scenic Rivers. Washington DC, typescript. 20 pp.

Chapman, A. G. 1967. Effects of spoil grading on tree growth. Mining Congress Journal 53(8):93-100.

Cole, Norman F., M. Ferraro, R. Mallary, J. F. Palmer, E. H. Zube. 1976. Visual design resources for surface mine reclamation. Institute for Man and Environment and ARSTECNICA Center for Art and Technology, University of Massachusetts, Amherst MA, Publication R-76-15:1-131.

Commissioners of the Ohio River Valley Water Sanitation Commission. 1975. Review of the Activities of the Commission in 1975. Orsanco, Cincinnati OH. 18 pp.

Commonwealth of Pennsylvania, Department of Environmental Resources, and Bureau of Outdoor Recreation, US Department of the Interior. 1976. Northeast regional states scenic rivers planning workshop, summary of proceedings,[Philadelphia PA?]. 125 pp.

Continental Oil Company. 1971. Microbiological treatment of acid mine drainage waters. US Environmental Protection Agency, Water Pollution Control Research Series, 14010 ENW 09/71. USGPO, Washington DC.

Core, Earl L. 1966. Vegetation of West Virginia. McClain Printing Co., Parsons WV. Second printing 1974. 217 pp.

Cross, A. T., and Schemal, M. P. 1955a. Geology of the Ohio River valley in West Virginia   Geology and economic resources of the Ohio River valley in West Virginia. West Virginia Geological Survey 22(1):1-149.

Cross, A. T., and Schemal, M. P. 1955b. Economic resources of the Ohio River valley in West Virginia. West Virginia Geological Survey 22(2):1-129.

Cunningham, Roger N. 1973. Paleo-hunters along the Ohio River. Archaeology of Eastern North America 1(1):1-8.

Davies, William E. 1958 [Reprinted with supplement, 1965]. Caverns of West Virginia. West Virginia Geologic and Economic Survey, 19a:1-330, supplement 1-72.

DePaulo, J. Raymond, Jr., and M. S. Baloch. 1968. Comprehensive water resources study of the Greenbrier River sub-basin, Inventory Volume I. West Virginia Department of Natural Resources, Division of Water Resources, Charleston WV. 130 pp.

Doll, Warwick L., B. M. Wilmoth, Jr., and G. W. Whetstone. 1960. Water resources of Kanawha County, West Virginia. West Virginia Geological and Economic Survey Bulletin 20:1-189.

Doll, Warwick L., G. Meyer, and R. Archer. 1963. Water resources of West Virginia. West Virginia Department of Natural Resources, Charleston WV. 134 pp.

Eggleston, Jane R., and R. E. Larese. 1975. Index to active surface mining in West Virginia. West Virginia Geological and Economic Survey, Morgantown WV. 54 pp.

Ferguson, Roland H. 1964. The timber resources of West Virginia. Northeastern Forest Experiment Station, Upper Darby PA. 121 pp.

Flint, Russell F. 1972. Fluvial sediment in Salem Fork watershed, West Virginia. US Geological Survey, Water-Supply Paper 1798-K: 1-29.

Folsom, Franklin. 1971. America's ancient treasures, guide to archaeological sites and museums. Rand McNally & Co., New York NY. 202 pp. (specifically, pp. 154-155).

Friel, Eugene A., and George L. Bain. 1971. Records of wells, springs, and test borings, chemical analyses of water, sediment analyses, standard streamflow data summaries, and selected drillers' logs from the Little Kanawha River basin in West Virginia. Prepared by US Geological Survey in cooperation with West Virginia Geological and Economic Survey and West Virginia Department of Natural Resources, Division of Water Resources. 76 pp.

Friel, Eugene A., W. A. Hobba, Jr., and J. L. Chisholm. 1975. Records of wells, springs, and streams in the Potomac River basin, West Virginia. Prepared by the US Geological Survey in cooperation with the West Virginia Geological and Economic Survey and West Virginia Department of Natural Resources, Division of Water Resources. 96 pp.

Friel, E. A., B. M. Wilmoth, P. E. Ward, and J. W. Wark. 1967. Water resources of the Monongahela River basin, West Virginia. Prepared by the US Geological Survey in cooperation with the West Virginia Department of Natural Resources and the West Virginia Geological and Economic Survey. 118 pp.

Frye, P. M., and G. R. Runner. 1970. A proposed streamflow data program for West Virginia. US Department of the Interior, Charleston WV. Variously paged.

Garton, Ray, M. E. Garton, and A. Carpenter. 1976. Caves of north central West Virginia. (Barbour, Harrison, Marion, Monongalia, Ohio, and Preston Counties). West Virginia Speleological Survey Bulletin 5:1-108.

Gillespie, William H., and John A. Glendening. 1964. West Virginia geology, archaeology, and pedology: A bibliography and index. West Virginia University Library, Morgantown WV. 241 pp.

GOFSR (Governor's Office of Federal-State Relations, Outdoor Recreation Division). 1975. Statewide comprehensive outdoor recreation plan. Prepared in cooperation with the West Virginia Department of Natural Resources. [Charleston WV]. Variously paged, 263 pp.

Gleason, Virginia E., and H. H. Russell. 1976. Mine drainage bibliography, 1910-1976. (Coal and the Environment Abstract Series). Bituminous Coal Research, Inc., for the US-EPA and Pennsylvania Department of Environmental Resources, Monroeville PA. 288 pp.

Goodwin, Richard H., and W. A. Niering. 1975. Inland wetlands of the United States evaluated as potential Registered Natural Landmarks. National Park Service Natural History Theme Studies 2:1-550.

Grim, Elmore C., and R. D. Hill. 1974. Environmental protection in surface mining of coal. National Environmental Research Center, Cincinnati OH. EPA Document EPA-670/2-74-093. USGPO, Washington DC. 292 pp.

Gulf Environmental Systems Company. 1971. Acid mine waste treatment using reverse osmosis. Environmental Protection Agency, Water Pollution Control Research Series 14010 DYG 08/71. USGPO, Washington DC. 85 pp.

Hanson, Lee, Jr. 1975. The Buffalo Site, a late seventeenth century Indian village site in Putnam County, West Virginia. West Virginia Geological and Economic Survey, Report of Archaeological Investigations 5:1-110.

Haigh, Martin J. 1976. Environmental problems associated with reclamation of old stri-mined land. Oklahoma Geology Notes 36(5): 200-202.

Hayhurst, Ruth I. (ed.). 1975. Current geological research in West Virginia - 1974. West Virginia Geological and Economic Survey, Morgantown WV. 17 pp.

Headlee, A. J. W. 1955. Characteristics of minable coals of West Virginia. West Virginia Geological Survey 3(A):1-166.

Hempel, John C. 1975. Caves of Monroe County. West Virginia Speleological Survey Bulletin 4:1-152.

Hittman Associates, Inc. 1975. Assessment of environmental impact of steep slope mining, baseline data survey, quarterly report 1. Prepared for West Virginia Surface Mining and Reclamation Association. Columbia MD. 47 pp.

Hittman Associates, Inc. 1975b. Assessment of environmental impact of steep slope mining, final baseline survey report. Prepared for West Virginia Surface Mining and Reclamation Association, Columbia MD. Variously paged, 191 pp.

Hittman Associates, Inc. 1976. Assessment of environmental impact of steep slope mining. Quarterly Report 3, Baseline data survey. Prepared for West Virginia Surface Mining and Reclamation Association. Columbia MD. Variously paged, 100 pp.

Horizons Incorporated. 1970. Treatment of acid mine drainage. Federal Water Quality Administration, Department of the Interior, Water Pollution Control Research Series 14010 DEE 12/70. USGPO, Washington DC.

Horn, Victor T., and J. K. McGuire. 1960. The climate of West Virginia. pp. 442-436 in Climates of the States, Volume I, Eastern states. Water Information Center, Inc., Port Washington NY. (1974).

Islam, M. N., and M. S. Baloch. 1973. Comprehensive survey of the Greenbrier River basin. Volume II, Part 2: Economic base study. West Virginia Department of Natural Resources, Division of Water Resources. Charleston WV. 133 pp.

Janssen, Raymond E. 1973. Earth science: A handbook on the geology of West Virginia. Educational Marketers, Inc. Clarksburg WV. 350 pp.

Jensen, Richard E. 1970. Archaeological survey of the Rawlesburg Reservoir area, West Virginia. West Virginia Geological and Economic Survey, Report of Archaeological Investigations 2:1-31.

Jones, William K. 1973. Hydrology of limestone karst in Greenbrier County, West Virginia. West Virginia Geological and Economic Survey Bulletin 36:1-49.

Kanawha Basin Comprehensive Study Coordinating Committee. 1971. Kanawha River comprehensive basin study. By the Committee [n.p.], 7 volumes, 3179 pp.

Katz, Max. 1969. The biological and ecological effects of acid mine drainage with particular emphasis to the waters of the Appalachian region. Prepared for the Appalachian Regional Commission. Seattle WA, 65 pp

King, Thomas F. 1975. Recommended procedures for archaeological impact evaluation. Los Angeles CA. 17 pp.

Lackey, James B. 1938. The flora and fauna of surface waters polluted by acid mine drainage. US Public Health Reports 53 (34):1499-1507.

Landers, Ronald A. 1976. A practical handbook for individual water-supply systems in West Virginia. West Virginia Geological and Economic Survey, Morgantown WV. 102 pp.

Landers, Ronald A., and P. Lessing. 1973. Bibliography of environmental geology in West Virginia. West Virginia Geological and Economic Survey, Environmental Geology Bulletin 8:1-33.

Landers, Ronald A., and R. A. Smosna. 1974. Improving stream-water quality in the Elk River basin. West Virginia Geological and Economic Survey. Report submitted to the Joint Committee on Government and Finance, West Virginia Legislature. 44 pp.

Larese, Richard E., J. R. Eggleston, R. Allison, Jr., and M. C. Behling. 1976. West Virginia mineral producers directory, Third Edition. West Virginia Geological and Economic Survey, Mineral Resources Series 1:1-156.

Larese, Richard E., and E. B. Nuhfer. 1976. Index to surface mining in West Virginia. West Virginia Geological and Economic Survey. Morgantown WV, 55 pp.

Lessing, Peter. 1974. Earthquake history of West Virginia. West Virginia Geological and Economic Survey, Environmental Geology Bulletin 12:1-12.

Lin, King L. 1976. 1976 coal traffic annual. National Coal Association, Washington DC.

Lotz, Charles W. 1970. Probable original minable extent of the bituminous coal seams in West Virginia. West Virginia Geological and Economic Survey, 1 sheet.

McGinsey, Charles R., III. 1972. Public archaeology. Seminar Press, New York NY. 265 pp.

McMichael, Edward V. 1965. Archaeological survey of Nicholas County, West Virginia. West Virginia Geological and Economic Survey Archaeological Series 1:1-100.

McMichael, Edward V. 1968. Introduction to West Virginia archaeology. West Virginia Geological and Economic Survey Educational Series 3:1-68.

Mallary, Robert and C. A. Carlozzi. 1976. The aesthetics of surface mine reclamation: An on-site survey in Appalachia, 1975-1976. Institute for Man and Environment ARSTECNICA Center for Art and Technology, University of Massachusetts, Amherst MA, Publication R-76-5:1-54.

Medville, Douglas M., and H. E. Medville. 1971. Caves of Randolph County. West Virginia Speleological Survey Bulletin 1:1-218.

Medville, Douglas M., and H. E. Medville. 1976. Caves and karst hydrology in northern Pocahontas County. West Virginia Speleological Survey Bulletin 6:1-174.

Michael Baker, Jr., Inc. 1975. Inactive and abandoned underground mines: Water pollution prevention and control. US Environmental Protection Agency, Office of Water and Hazardous Materials, Washington DC. 338 pp.

Mineral Resources Research Center. 1971. Flocculation and clarification of mineral suspensions. US Environmental Protection Agency, Water Quality Office, Water Pollution Control Series, 14010 DRB 05/71. USGPO, Washington DC.

Michie's West Virginia Code. 1974. Laws, Department of Natural Resources, State of West Virginia. The Michie Company, Charlottesville VA. 259 pp.

Michie's West Virginia Code. 1975. Laws, Department of Natural Resources, State of West Virginia, 1975 Supplement. Charlottesville VA. 48 pp.

Mining Enforcement and Safety Administration. 1975. Final environmental statement, regulations governing the disposal of coal mine waste (30 CFR Part 77, Sections 77.215.h through 77.217). United States Department of the Interior, Washington DC. Variously paged, 230 pp.

Mining Informational Services. 1975. 1975 Keystone coal industry manual. McGraw-Hill, New York NY. 782 pp.

Nace, R. L., and P. P. Bieber. 1958. Groundwater resources of Harrison County, West Virginia. West Virginia Geological and Economic Survey Bulletin 14:1-55.

National Coal Association/Bituminous Coal Research, Inc. 1976. Third symposium on coal utilization, Louisville KY. 233 pp.

National Coal Association/Bituminous Coal Research, Inc. 1976. Sixth symposium on coal mine drainage, Louisville KY. By the Association, Washington DC. 291 pp.

Nielsen, George F. (Editor). 1975. 1975 coal mine directory, United States and Canada. McGraw-Hill, Inc., New York NY. 319 pp.

Nolting, J. P., Jr. 1940. Characteristics of minable coals of West Virginia. West Virginia Geological Survey 13:1-272.

NPS (National Park Service). 1972. Areas administered by the National Park Service and related properties as of January 1, 1972. USGPO, Washington DC, 192 pp.

NPS (National Park Service). 1973. Preparation of environmental statements: Guidelines for discussion of cultural (historic, archaeological, architectural) resources. Prepared in cooperation with the Office of Environmental Project Review, Washington DC. Variously paged, 34 pp.

NPS (National Park Service). 1975. Index of the National Park System and affiliated areas as of January 1, 1975. USGPO, Washington DC, 136 pp.

NPS (National Park Service). 1976. The National Register of Historic Places: Notification of pending nominations. 41 Federal Register 28:5841-5854.

NUS Corporation, Cyrus W. Rice Division. 1971. The effects of various gas atmospheres on the oxidation of coal mine pyrites. US Environmental Protection Agency, Water Pollution Control Research Series 14010 ECC 08/71. USGPO, Washington DC. 144 pp.

Ohio River Basin Commission. 1975. Monongahela River basin water and related land resources Level B study report and environmental impact statement. Cincinnati OH. 216 pp.

Platt, Robert B. 1951. An ecological study of the Mid-Appalachian shale barrens and of the plants endemic to them. Ecological Monographs 21:269-300.

Renton, John J., and R. V. Hidalgo. 1975. Some geochemical considerations of coal. West Virginia Geological and Economic Survey, Coal-Geology Bulletin 4:1-46.

Renton, John J., R. V. Hidalgo, and D. L. Streib. 1973. Relative acid-producing potential of coal. West Virginia Geological and Economic Survey, Environmental Geology Bulletin 11:1-7.

Resource Planning Associates, Inc. 1975. Energy supply/demand alternatives for the Appalachian Region. A report to the Appalachian Regional Commission. Boston MA. Variously paged.

Rex Chainbelt, Inc. 1970. Treatment of acid mine drainage by reverse osmosis. Commonwealth of Pennsylvania and the Federal Water Quality Administration, US Department of the Interior. Water Pollution Control Research Series 14010 DYK 03/70. USGPO, Washington DC. 35 pp.

Rex Chainbelt, Inc. 1972. Reverse osmosis demineralization of acid mine drainage. Commonwealth of Pennsylvania and US Environmental Protection Agency, Office of Research and Monitoring. Water Pollution Control Research Series 14010 FQR 03/72. USGPO, Washington DC. 111 pp.

Rhodehamel, Edward C., and Charles W. Carlston. 1963. Geologic history of the Teays valley in West Virginia. Geological Society of America Bulletin 74:251-274.

Robert R. Nathan Associates, Inc. 1969. Mine drainage pollution and recreation in Appalachia. Prepared for the Appalachian Regional Commission, Washington DC. 114 pp.

Robinson, Tully M. 1964. Occurrence and availability of groundwater in Ohio County, West Virginia. West Virginia Geological and Economic Survey Bulletin 27:1-57.

Sack, W. A., C. R. Jenkins, B. R. Chamber, and R. W. Lange, II. 1976. Modeling of acid mine drainage and other pollutants in the Monongahela River basin under low flow conditions. West Virginia Department of Natural Resources, Division of Water Resources, Charleston WV. 159 pp.

Scenic Rivers Task Force. 1973. Birch River - a pilot study. [WV-DNR? Charleston WV] Typescript, 9 pp.

Seals, Roger K. ,and others. 1972. Failure of Dam No. 3 on the middle fork of Buffalo Creek near Saunders, West Virginia. National Academy of Engineering, Committee on National Disasters. 32 pp.

Shaw, Samuel P., and C. Gordon Fredine. 1965. (Reprinted 1971). Wetlands of the United States, their extent and their value to waterfowl and other wildlife. United States Department of the Interior, Fish and Wildlife Service, Washington DC. 67 pp.

Skelly and Loy, Engineers-Consultants, and Penn Environmental Consultants, Inc. 1973. Processes, procedures, and methods to control pollution from mining activities. EPA-430/9-73-011. USGPO, Washington DC. 390 pp.

Smith, Richard M., A. A. Sobek, T. Arkle, Jr., J. C. Sencindiver, and J. R. Freeman. 1976. Extensive overburden potentials for soil and water quality. EPA-600/2-76-184. Office of Research and Development, Industrial Environmental Research Laboratory, Cincinnati OH. 310 pp.

Smith, Richard M., W. E. Grube, Jr., T. Arkle, Jr., and A. Sobek. 1974. Mine spoil potentials for soil and water quality. Report EPA-670/2-74-070 to the National Environmental Research Center, Office of Research and Development, US-EPA, Cincinnati OH. 302 pp.

Smith, R. M., G. G. Pohlman, and D. R. Browning. 1945. Some soil properties which influence the use of land in West Virginia. West Virginia University Bulletin 321.

Society for American Archaeology. No date. Archaeology and archaeological resources: A guide for those planning to use, affect, or alter the land's surface. Washington DC. 24 pp.

Soil Conservation Service. 1970. West Virginia soil and conservation needs inventory. Morgantown WV. 189 pp.

Southern Soil Conservation District and the State Soil Conservation Committee. 1969. The story of Brush Creek, Mercer County, West Virginia. Variously paged (85 pp.).

Stanford Research Institute. 1972. Final report on a study of surface coal mining in West Virginia. Prepared for West Virginia Legislature, Joint Committee on Government and Finance, Charleston WV. Menlo Park CA, 180 pp.

Thompson, Robert D. and H. F. York. 1975. The reserve base of US coals by sulfur content, I, The eastern states. US Bureau of Mines Information Circular.

Tyco Laboratories, Inc. 1971. Silicate treatment for acid mine drainage prevention. Tyco Laboratories, Inc., Watham MA. US Environmental Protection Agency, Water Pollution Control Series 14010 DLI 02/71. USGPO, Washington DC. 96 pp.

US Congress, House, Committee on Interior and Insular Affairs, Subcommittee on Mines and Mining. 1971. Interior Department mines and mining orientation briefing (19 May 1971), 92nd Congress, 1st Session. USGPO, Washington DC, 132 pp.

US Congress, House, Committee on Interior and Insular Affairs, Subcommittee on Mines and Mining. 1972. Regulation of strip mining, hearings (20 September - 30 November 1971), 92nd Congress, 1st Session, on H. R. 60 and related bills. USGPO, Washington DC, 890 pp.

US Congress, Senate, Committee on Interior and Insular Affairs. 1971a. The issues related to surface mining, 92nd Congress, 1st Session. Committee print serial no. 92-10. USGPO, Washington DC, 255 pp.

US Congress, Senate, Committee on Interior and Insular Affairs. 1971b. Legislative proposals concerning surface mining of coal, 92nd Congress, 1st Session. Committee print. USGPO, Washington DC, 25 pp.

US Congress, Senate, Committee on Interior and Insular Affairs. 1972a. Hearings, 92nd Congress, 1st Session, S. 1498, S. 2455, and S. 2777, pending surface mining legislation, Parts 1 and 2. USGPO, Washington DC, 882 pp.

US Congress, Senate, Committee on Interior and Insular Affairs. 1972b. Hearings (24 February 1972) 92nd Congress, 1st Session, pursuant to S. Res. 45, a National fuels and energy policy study, on S. 2777 and S. 3000, Part 3. USGPO, Washington DC, pp. 883-1173.

US Congress, Senate, Committee on Interior and Insular Affairs. 1973a. Regulation of surface mining operations, hearings (13-16 March 1973), 93rd Congress, 1st Session, on S. 425 [and] S. 923, Parts 1 and 2. USGPO, Washington DC, 1,410 pp.

US Congress, Senate, Committee on Interior and Insular Affairs, Subcommittee on Minerals, Materials, and Fuels. 1973b. Coal surface mining and reclamation, hearings (30 April 1973). USGPO, Washington DC, 85 pp.

US Congress, Senate, Committee on Interior and Insular Affairs. 1973c. Coal surface mining and reclamation, 93rd Congress, 1st Session. Committee print serial no. 93-8 (92-43). USGPO, Washington DC, 143 pp.

US Congress, Senate, Committee on Interior and Insular Affairs. 1973d. Factors affecting the use of coal in present and future energy markets, 93rd Congress, 1st Session. Committee print serial no. 93-9 (92-44), USGPO, Washington DC, 43 pp.

US Congress, Senate, Committee on Interior and Insular Affairs. 1973e. Surface mining reclamation act of 1972, report to accompany S. 425, 93rd Congress, 1st Session. Senate report 93-402. USGPO, Washington DC, 94 pp.

USBM (Bureau of Mines). 1971. Strippable reserves of bituminous coal and lignite in the United States, Bureau of Mines Information Circular/1971 IC 8531. Washington DC. 148 pp.

USDA-SCS (US Department of Agriculture, Soil Conservation Service). 1961. Soil survey, Jackson and Mason Counties, West Virginia. Series 1957 (11):1-127.

USDA-SCS (US Department of Agriculture, Soil Conservation Service, Morgantown District). 1974. Erosion and sediment control handbook for urban areas. Morgantown WV. 154 pp. with appendices A-D.

USDA-SCS (US Department of Agriculture, Soil Conservation Service, Morgantown District). 1975. Draft environmental impact statement, North and South Mill Creek watershed. Morgantown WV. Variously paged, 115 pp.

USDA-SCS (US Department of Agriculture, Soil Conservation Service, Morgantown District). 1975. Elk Creek Watershed, Barbour, Harrison, and Upshur Counties, West Virginia. Environmental statement for watershed protection and flood prevention. Morgantown WV. Variously paged, 170 pp.

USDI-GS (US Department of the Interior, Geological Survey). 1964, 1965, 1970. Water resources data for West Virginia. US Geological Survey, Water Resources Division. Charleston WV.

US-EPA (Environmental Protection Agency). 1973. Processes, procedures, and methods to control pollution from mining activities. EPA-430/9-73-011. USGPO, Washington DC. 390 pp.

US-EPA (Environmental Protection Agency). 1975a. Environmental impact assessment guidelines for selected new source industries. Office of Federal Activities, Washington DC, variously paged.

US-EPA (Environmental Protection Agency). 1975b. Review of mining and mining-related environmental impact statements (surface coal mining section draft). Office of Federal Activities, Washington DC. Typescript, 153 pp.

US-EPA (Environmental Protection Agency). 1975c. Criteria for developing pollution abatement programs for inactive and abandoned mine sites. EPA-440/9-75-008. Washington DC. 467 pp.

US-EPA (Environmental Protection Agency). 1975d. Development document for interim final effluent limitations guidelines and new source performance standards for the coal mining point source category. EPA-440/1-75-057. Washington DC. 288 pp.

US-EPA (Environmental Protection Agency). 1975e. Inactive and abandoned underground mines: Water pollution prevention and control. EPA-440/9-75-007. Washington DC. 338 pp.

US-EPA (Environmental Protection Agency). 1975f. Decision of the General Counsel on matters of law pursuant to 40 CFR 125.36.m. [the extent of regulatory authority over waterways]. Decision No. 7. Mimeographed, US-EPA, Washington DC, 4 pp.

US-EPA (Environmental Protection Agency). 1976. Erosion and sediment control, surface mining in the eastern United States, planning and design. EPA-625/3-76-006. USGPO Region 5-11. 238 pp.

US-EPA (Environmental Protection Agency). 1976b. Environmental assessment of surface mining methods: head-of-hollow fill and mountaintop removal. Monthly Progress Report, 31 July 1976. Region III, Philadelphia PA. 17 pp.

USFS (United States Forest Service). 1970. Coal mining, the situation and its management [in the] Monongahela National Forest. US Department of Agriculture, Elkins WV. 4 pp.

USFS (United States Forest Service, Eastern Region). 1977. Draft environmental impact statement and land management plan for the Monongahela National Forest. USGPO, Region 5-1, 750-359/14. Variously paged, 239 pp.

US-FWS (United States Fish and Wildlife Service). 1954. Wetland inventory of West Virginia. Office of River Basin Studies, Boston MA, mimeographed, 19 pp.

US Geological Survey and the Bureau of Land Management. [1976]. Surface management of federal coal resources (43 CFR 3041) and coal mining operating regulations (30 CFR 211), final environmental statement. US Department of the Interior, [Washington DC,] Variously paged, 676 pp.

Vogt, Sage, and Pflum, Consultants. 1970. Phase II development plan report, comprehensive planning program, Jackson County, West Virginia. Cincinnati OH. 82 pp.

Ward, Porter E., and B. M. Wilmoth. 1968. Groundwater hydrology of the Monongahela River basin in West Virginia. West Virginia Geological and Economic Survey, River Basin Bulletin 1:1-54.

Warner, Don L. 1974. Rationale and methodology for monitoring groundwater polluted by mining activities. General Electric Co., Santa Barbara CA. EPA-680/4-74-003, 68 01 0759. 85 pp.

Werner, Eberhard. 1972. Development of solution features, Cloverlick Valley, Pocahontas County. West Virginia Speleological Survey Bulletin 2:1-53.

West Virginia Geological Survey. 1956. Geology and economic resources of the Ohio River valley in West Virginia. West Virginia Geological Survey 22:1-408.

West Virginia Historic Commission. 1967. West Virginia highway markers, historic, prehistoric, scenic, geological. Revised Edition. Biggs-Johnston-Withrow, Beckley WV. 263 pp.

West Virginia Surface Mining and Reclamation Association. [1974?] Procedure for obtaining a surface mining permit in West Virginia. Prepared for West Virginia surface miners in cooperation with West Virginia Department of Natural Resources, Divisions of Planning and Development, Reclamation, and Water Resources. Charleston WV. 140 pp.

Wilderness Committee, West Virginia Highlands Conservancy. 1973a. The Dolly Sods Area -- 32,000 acres in and adjacent to the Monongahela National Forest, West Virginia. Fourth Edition, mimeographed by the Conservancy, Huntington WV, 75 pp.

Wilderness Committee, West Virginia Highlands Conservancy. 1973b. Otter Creek. Fourth Edition. West Virginia Highlands Conservancy, Huntington WV. 31 pp.

Wildlife Resources Division. 1974. Species status and recommendations for the West Virginia wildlife resources plan. Department of Natural Resources, Elkins WV. 3 volumes.

Wilmoth, Benton N. 1966. Groundwater in Mason and Putnam Counties, West Virginia. West Virginia Geological and Economic Survey Bulletin 32:1-152.

Wilmoth, Roger C., and Ronald D. Hill. 1970. Neutralization of high ferric iron acid mine drainage. US Department of the Interior, Federal Water Quality Administration. Robert A. Taft Research Center. Water Pollution Control Research Series 14010 ETV 08/70. USGPO, Washington DC. 42 pp.

WVCA (West Virginia Coal Association). 1975. Coal facts. By the Association, Charleston WV. 42 pp.

WVCA (West Virginia Coal Association). 1976. West Virginia coal facts, 1976. By the Association, Charleston WV. 42 pp.

WVDM (West Virginia Department of Mines). 1969, 1970, 1971, 1972, 1974, 1975. Annual report. Charleston WV.

WVDM (West Virginia Department of Mines). 1970, 1971, 1972, 1973, 1974, 1975. Directory of Mines. Charleston WV.

WVDM (West Virginia Department of Mines). 1975 . Annual report to the Honorable Arch A. Moore, Jr., Governor. By the Department, Charleston WV. 74 pp.

WV-DOC (West Virginia Department of Commerce). 1973. 1973 West Virginia economic profile. West Virginia Department of Commerce, Charleston WV. 46 pp.

WV-DOC (West Virginia Department of Commerce, Industrial Development Division). 1974. West Virginia industrial data file. Prepared for WAPORA, Inc. Charleston WV. Variously paged.

WV-DOC (West Virginia Department of Commerce). 1976. West Virginia economic profile. Charleston WV. 64 pp.

WV-DNR (West Virginia Department of Natural Resources). 1972. Lakes of West Virginia. Division of Water Resources, Charleston WV. 82 pp.

WV-DNR (West Virginia Department of Natural Resources). 1973a. West Virginia water quality network, compilation of data 1969. West Virginia Department of Natural Resources, Division of Water Resources, Charleston WV. 151 pp.

WV-DNR (West Virginia Department of Natural Resources). 1973b. Comprehensive survey of Potomac River basin. Vol. I Inventory. Division of Water Resources, Charleston WV. 220 pp.

WV-DNR (West Virginia Department of Natural Resources). 1974. West Virginia high quality streams, third edition. Division of Wildlife Resources, Charleston WV. 47 pp.

WV-DNR (West Virginia Department of Natural Resources). 1975a. Annual interagency evaluation of surface mine reclamation in West Virginia. Division of Reclamation, Charleston WV. 54 pp.

WV-DNR (West Virginia Department of Natural Resources). 1975b. State of West Virginia draft basin water quality management plan for the Kanawha River basin. Division of Water Resources, Charleston WV. Variously paged, 615 pp.

WV-DNR (West Virginia Department of Natural Resources). 1975c. Drainage handbook for surface mining. Division of Reclamation, Division of Planning and Development and Division of Reclamation in cooperation with Soil Conservation Service, USDA. Variously paged, 136 pp.

WV-DNR (West Virginia Department of Natural Resources). 1976a. State of West Virginia draft basin water quality management plan for the Big Sandy-Tug Fork river basin. Division of Water Resources, Charleston WV. Variously paged, 270 pp.

WV-DNR (West Virginia Department of Natural Resources). 1976b. State of West Virginia draft basin water quality management plan for the Guyandotte river basin. Division of Water Resources, Charleston WV. Variously paged, 313 pp.

WV-DNR (West Virginia Department of Natural Resources). 1976c. State of West Virginia draft basin water quality management plan for the Little Kanawha river basin. Division of Water Resources, Charleston WV. Variously paged, 201 pp.

WV-DNR (West Virginia Department of Natural Resources). 1976d. State of West Virginia draft basin water quality management plan for the Monongahela river basin. Division of Water Resources, Charleston WV. Variously paged, 536 pp.

WV-DNR (West Virginia Department of Natural Resources). 1976e. State of West Virginia draft basin water quality management plan for the Ohio river basin. Division of Water Resources, Charleston WV. Variously paged, 287 pp.

WV-DNR (West Virginia Department of Natural Resources). 1976f. State of West Virginia draft basin water quality management plan for the Potomac river basin. Division of Water Resources, Charleston WV. Variously paged, 257 pp.

WV-DNR (West Virginia Department of Natural Resources). 1976g. Annual interagency evaluation of surface mine reclamation in West Virginia. Division of Reclamation, Charleston WV. 73 pp.